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GEOLOGY AND PALÆONTOLOGY.

THE MASTODON.

BY. PROF. G. C. BROADHEAD.

During the winter of 1879-80, Mr. R. A. Blair, of Sedalia, Mo., has, through his industry and perseverance, his own personal labor and the expenditure of some money, become the possessor, in his own right, of a very fine collection of mastodon remains. They were obtained from a spring at Mr. Wade Mosby's, seven miles southeast of Sedalia. About fifteen years ago Mr. M., in placing a "gum," or section of a hollow log, in his spring, found a few large bones and the fragments of a tusk. But until the fall of 1879 no examinations or searchings for bones were made. At that time Mr. R. A. Blair, becoming interested in the matter, began to work in earnest, and the result was the finding of the large collection now in his possession.

The surface of the ground at the spring, where the bones were obtained, is about fifteen feet above the creek, which is about four hundred feet distant. The upper spring is about five feet higher than the other spring and ninety feet distant. They lie about two hundred feet from the base of the hill, just back which rises up by gentle slopes. Mr. Blair dug a ditch from the spring toward the creek, passing through alluvial loam to a bed of gravel, which seems to lie nearly level and to pass beneath the spring, or six to eight feet from the surface, approaching the surface toward the creek. The gravel was not passed through. Blue clay rested upon the gravel. The diameter of the spring and bog seemed to be about twenty feet. It may originally have been a little larger. The material within

this diameter was a light spongy, peaty humus, containing the mastodon bones and pieces of wood resembling cypress. A fine gray sand occurred at the bottom and bright blue sand would boil up toward the top. Only in this funnel-shaped space of fifteen feet in diameter at top were found the mastodon remains, occurring from three to eight feet in depth and including fragments of both large and small individuals, and in number about eight skeletons. Perfect heads, with the teeth attached, were obtained. The tusks were much broken. Other bones, both of the leg and ribs, were obtained, and also vertebræ. The largest tusks indicated about seven feet length, the hollow portions of which were filled with black clay. Some of the older teeth were nearly entire, while those of younger individuals were much worn. Some jaws show young teeth in front of old ones, as if shedding and replacing others. The jaws had from two to four teeth on a side, some 2 inches square to 4½x8. A jaw with only two teeth has one of them 4x8 inches, the other 4x3½ inches. The largest tusk observed was about five inches in diameter at large end, the whole gently curved. A few flint implements (spear heads) and one stone club were found with the bones.

Mr. Blair has preserved the remains, and placed them in cases so they can be well seen. His is the *Mastodon Americanus cuvier.*

Dr. Albert Koch was the first person who made explorations by digging for mastodon remains in Missouri. In 1839 he exhumed certain bones from a spring on the Bourbeuse river, in Gasconade county, Missouri. Dr. K. thought these bones had been partially burned; this, however, has been disbelieved by others, so it remains in doubt. Arrow heads of flint, and stone axes, were also found. In the material at the bottom, which Dr. K. considered ashes, there was much gravel, above this was eight feet of clay and sand, from which flowed the spring and in which lay the bones.

About 1840 Dr. Koch dug out the bones of another mastodon, in the valley of Pomme de Terre river, ten miles southwest of Warsaw. Dr. K. states that an arrow head was here found beneath the thigh bone of the animal. With them was also found fragments of wood and roots, with logs and cones of the cypress, together with flint implements. The bones were overlaid by distinct layers of clay, sand and gravel, to the thickness of twenty feet, which sustained above a growth of old trees.

Lay, in his history of Benton county, speaks of these bones and states that they have been found in two places in the county; one on the farm of the heirs of Charles Wickliffe, on the Osage, the other near the farm of Alexander Brashears, on the Big Pomme de Terre. From the Wickliffe farm nearly a whole skeleton was taken to Cincinnati, of which a tusk was said to be nine feet long. Other bones were also obtained at the same place.

The Messrs. Bradley, of Boone county, kept fifteen or twenty hands at work for several months on the Brashears place, and took out a great many bones. But they were so much decomposed, that after exposure they fell to pieces, and the men lost money by the venture.

Dr. Koch states that, at one time, he had six hundred teeth of mastodon, all found in Missouri, and nearly an entire skeleton was obtained from Benton county, which was afterward sold to the British museum. This he called the "Missourium." It is the *Mastodon Americanus* (*giganteus*). Its extreme length was 20 feet 2 inches; height, 9 feet 6¾ inches; length of cranium, 3½ feet; its vertical dimensions 4 feet, width 2 feet 11 inches; width of pelvis, 5 feet 8 inches; extreme length of tusks 7 feet 2 inches, projection of same 5 feet 2 inches, circumference at base, 27 inches.

On the Osage and its tributaries are extensive deposits of clay resting on sand and gravel; at the bottom of the clay there are occasionally found remains of extinct mammalia, the mastodon, horse, ox, etc. On the Marais des Cygnes, at Papinville, we find these beds as follows, counting from top:

1.—30 feet 10 inches yellow clay;

2.—4 inches blue clay and gravel;

3.—5 feet sand and gravel, the latter sometimes partially cemented together.

At Burnett's ferry, Bates county, we find—

1.—10 feet sandy clay;

2.—10 feet blue clay with pebbles.

In the gravel beds at Papinville, a tooth of an extinct species of horse was found, together with fresh water shells. On the river bluff near by, a mastodon tusk 7 feet 4 inches long was found in the gravel.

Mr. H. H. West discovered, in the Loess of Kansas City, a portion of the tusk of a mastodon, an account of which he published in the REVIEW. This may have drifted from deposits a little older, or more probably washed into the Loess lake from the adjacent shore.

Mr. J. C. Evans obtained a large tooth of a mastodon from Line creek, Platte county. This was probably washed out from the later glacial clay.

A mastodon tooth has also been obtained in Caldwell county.

The Kansas City REVIEW for March, 1880, gives an account by Dr. Ballard of the discovery of mastodon remains in the Eastern part of Jackson county. Dr. B. gives the size of tusk as 14 inches in diameter(!)—from imprint in clay—and 12 feet long. This is of greater dimensions than any I have ever seen or heard of before.

The above are notices of such remains that I know of having been found in Missouri. We will now speak of mastodon remains in other states.

In the REVIEW for September, 1877, is a brief notice of remains on Bijou creek, in Colorado. Only leg bones were obtained, but were of large dimensions, measuring 29½ inches in circumference at upper end.

Remains have been found at several places in Kansas, chiefly in valley of Marais des Cygnes, some in Miami county, and some in Franklin county. Other bones have been found near Emporia.

Prof. Woodman exhumed a mastodon at Melton, Iowa, twenty five miles west of Davenport, from the bank of a stream, in an excellent state of preservation. It indicated a height of fourteen feet.

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The Wheaton mastodon, found in Du Page county, Illinois, was obtained four feet below the surface in a boggy place. It was probably 14 feet in height and 20 feet long.

From Big Bone Lick, Boone county, Ky., it is said that fragments of one hundred skeletons of the mastodon have been exhumed. It is a fact connected with the occurrence of these bones, as well as those found on the Osage and in all boggy places, that they seem as if the animals had come there to drink or lick, and had stuck in the mud so as to be unable to extricate themselves. To this fact science is indebted for the excellent state of preservation in which the remains occur.

In various parts of North America we find marshy tracts abounding in salt or brackish waters, which, during the present generation, are much resorted to by the deer and other animals. These places are called "licks," and are found at many places in Missouri.

The Big Bone Lick, Kentucky, is traversed by a small stream of brackish water. Its bottom consists of black, fetid mud, intermingled with sand and traces of vegetable matter. In this bog, bones of great magnitude have been found in great numbers. Mantell informs us that a fine skull with teeth, from the Big Bone Lick, had been placed in the British museum at a cost of 150 guineas. The length of the skull is 36 inches.

Mastodon bones have been found in several other portions of Kentucky, some in Henry, and also in Owen county. Skeletons of the great Mastodon have also been found in bogs in Louisiana in a vertical position, as if they had sunk in the mire; and one found in New Jersey, forty miles south of New York, was found in black earth, in the same position, as if it had sunk in the mire. The remains of the *Mastodon Americanus* have been found at several other localities n the more recent bog and lacustrine deposits of New Jersey. The most remarkable of these were found on the farm of William Ayers, half way between Vienna and Hackettstown, in Warren county. Six skeletons were found in this bog, and they were covered by six feet of mud. A small pond now occupies the place of this bog. Lyell informs us that five skeletons were lying together, and that many of the bones crumbled very much upon exposure. But nearly the whole of the other skeleton, which lay ten feet apart from the rest, was preserved entire, and had twenty ribs, like the elephant. From the clay in the interior, or where the contents of the stomach should be, seven bushels of vegetable matter were extracted. A microscopic examination showed it to consist of pieces of small twigs of a coniferous tree, of the cypress family, probably the shoots of *Thuja occidentalis* (Am. *arbor vitæ*).

Another tooth was also found half a mile northeast of this; also in same county, on farm of Charles Howell, an imperfect skeleton. These remains were probably taken to New York. Other remains were obtained near Greensville, Sussex county; also at three places in Monmouth county, and a portion of a jaw in a mill-race near Marlbro, at Hartshorn's mill, and near Freehold, and a very perfect tooth near Verona, Essex county.

Bones of the Mastodon have been found at numerous places in the State of New York, especially in the western part. We quote from the New York Geological Reports: "In the bank of a stream, in gravel and sand, near the town of Perrinton, and now in the Rochester Museum.

"In 1838, during the excavation of the Genesee Valley canal in the city of Rochester, a tusk, some bones of the head, several ribs and other bones were found, intermingled with gravel and sand, and covered by clay and loam, and above these a deposit of shell marl. The tusk was nine feet long.

"During the excavation of the Erie canal, a large molar tooth was found in a swamp near Holley, Orleans county.

"In the fine gravel and loam, containing fresh water shells, and evidently a fluviatile deposit, at Niagara Falls, a molar tooth was found.

"In a muck swamp in Stafford, Genesee county, a small molar tooth was found. In 1841, a molar tooth, weighing two pounds, was found in a bed of marl three miles south of Leroy. At Geneseo, in Livingston county, a large number of bones and several teeth were found in a swamp, beneath a deposit of muck, intermingled with a sandy, calcareous marl.

"At Hinsdale, Cattaraugus county, a tusk, with some horns of deer, were found, sixteen feet below the surface, in gravel and sand.

"At Jamestown, Chautauqua county, a tooth of a Mastodon was found, several feet beneath the surface, in gravel.

"In speaking of the occurrence of these bones, Prof. James Hall says that these bones often occur imbedded in gravel and sand of the nature of the ordinary drift; but, in such instances, it can usually be shown that they have been transported and the deposit in which they occur is one of very modern origin.*

The marl beds and muck swamps rest upon the drift. The gravel beds occurring with the bones are evidently of transported drift.

"The earliest records that we have of the bones of the Mastodon is a letter from Cotton or Increase Mather to the Royal Society of London, between 1650 and 1700, describing the bones of one of these animals found near Albany.†

"The bones of the Mastodon are frequently found in the peat bogs of Orange and Ulster counties. Bones of Mastodon were found in 1790-'91, and in 1800, in the town of Montgomery, twelve miles from Newburgh, Orange county. They were ten feet below the surface, in a peat bog. One of the leg bones measured more than forty inches around the joint, and thirty-six on the cylindrical part of the bone, and nearly five feet long; the teeth, nearly seven inches long and four broad, were found white, fast in the jaw, and with no appearance of decay. The orifice in the back bone, where the marrow was, was three and a half inches in diameter. Eight similar skeletons have been discovered within eight or ten miles of this, some of them fifteen to twenty feet below the surface. A Mastodon, exhumed at Newburgh in 1845, indicated the following dimensions: Height, 11 feet; length to base of tail, 17 feet; tusks, 12 feet long—2½ feet

*Nat. His. N. Y., part 4, Geology, 4th Dis. p. 365.
†Ibid. Geology, 1st Dist., p. 47.

inserted in sockets. When alive, it must have been twelve or thirteen feet high, and length, including seven feet for tusks, twenty-five feet.* It was found in peat, with a thin layer of fresh water marl above it.

Prof. H. A. Ward, of Rochester, N. Y., has in his museum twenty-seven casts of Mastodon, embracing nine species, of which *M. Arvernensis*, of Europe, and *M. Americanus*, of America, are from the Pleistocene or Quaternary. *M. borsoni*, *M. affinis*, *M. dissimilis*, *M. insignis*, are from Pliocene, of France. *M. longirostris*, from Miocene of France. *M. elephantoides*, *M. andium*, from Miocene of India.

In the twenty-first annual report of the Board of Regents of the New York University, Prof. James Hall furnishes an interesting account of the discovery of the bones of *Mastodon giganteus* (*M. Americanus*) at Cohoes, in the valley of the Mohawk river, State of New York, in September, 1866.

The bones were found in a pot-hole, which was sounded and found to be over sixty feet in depth, filled with clay and soil on top, and peaty clay, with branches and trunks of trees below. The lower jaw was found about twenty-five feet from the surface; the other bones below. This "pot-hole" showed that, previous to the deposition of the mastodon remains and the subsequent filling up of the "hole," powerful agencies had been at work. Subsequent explorations revealed portions of the skeleton sixty feet distant and 20 feet higher than the bones in the pot-hole, but by comparison it proved to be part of the same skeleton. Prof. Hall reasons that the mastodon had floated down the Mohawk when its bed was more than one hundred feet above its present level, and lodging upon its rocks had gradually become dismembered and its parts transported to different points, and there deposited upon the disintegration and melting away of the glacier.

It would further appear that, during the glacial period, the surface water, falling through the crevices in the vast ice mass, had eroded deep cavities in the rocks below. Into these, fragments of rocks fell, and, being continually acted upon by the water for a long time, kept the fragments in motion, wearing around the incipient pot-hole. Toward the close of the glacial period, a mastodon which had become frozen into the ice mass, became disengaged and fell into these holes.

A few measurements of the Cohoes Mastodon are as follows:

Circumference of tusk	18¼ inches
Length "	4 ft. 9 in.
Length first rib	2 feet
Circumference of rib at Middle	6¼ in.
Length of Ulna	2½ ft.
" Radius	2 ft. 3 in.
" Femur	3 ft. 5½ in.
" Tibia	2 ft. 2 in.
" Fibula	22½ in.

* Dana, p, 567.

The Warren skeleton (from near Newburgh) is of maximum size, suppo ing unusually long and large tusks, armed with inferior canine teeth and exhibiting a small pelvic aperture; is undoubtedly a male. The Cambridge Mastodon is much smaller, though nearly as old, with short and slender tusks above and none below, and a large pelvic aperture; is a female. The Cohoes skeleton, of the same age of the Cambridge, has a comparative small pelvic aperture, proving it to be a male.

A few bones of the Mastodon have been found near New Britain and Cheshire, Connecticut.

Mastodon teeth were found at Pittstown, Luzerne county, Pa., associated with teeth of *Equus major* and *Bison latifrons*.

A tooth of a Mastodon found in Quaternary, of Niagara, indicates that six miles of the gorge have been excavated since he existed. (Dana, p. 510.)

Four grinders of a Mastodon—one sixteen inches in circumference—were found in Kishaco, Quillas Valley, Pennsylvainia, resting upon rounded pebbles and covered with a few feet of alluvium.

Prof. H. D. Rogers informs us that the pleistocene beds of shelly sands cover a broad belt of country on the Atlantic coast of Virginia and North Carolina as far as Pamlico sound. These beds contain many shells identical with species now occurring on the Atlantic coast and one or two now only living in the warmer waters of the Gulf of Mexico. Mixed with these shells are the bones and teeth of several extinct land quadrupeds, including the fossil elephant and the *Mastodon giganteus* and a large species of extinct horse.

Prof. Emmons informs us that the bones of the Mastodon are not uncommon in the miocene marl of North Carolina and instances localities in Halifax county, in a marl pit in Nash, upon the Cape Fear, and at other places.

Prof. Kerr informs us that the whole eastern portion of North Carolina, a tract extending more than a hundred miles from the coast and rising 500 feet above the sea along its western margin, is covered chiefly with a deposit of shingle, gravel, sand and clay, the coarser to the west, the finer near the coast. This covers nearly the whole of the Tertiary and Cretaceous, a considerable part of the Triassic and part of the Archæan. The eastern band of this, rising to 100 feet elevation above tide, is assigned to the *Glacial period* or early Quaternary, consisting in the lower part especially, of coarse pebbles associated with fossils in the form of sharks' teeth, coprolites and bones, and here have been found the best preserved Mastodon teeth and bones. Prof. Hilgard, maintaining the occurrence of Mastodon bones in the Loess of Mississippi, says they are generally found singly, but that portions of the skeleton have been found in spots where ponds existed, as though the animal had perished there. In such places the bones are frequently in contact with masses of black fatty earth, probably decomposed animal matter.

In Martin county, Indiana, bones of the Mammoth and the Mastodon have been found in marsh clay, resting on the drift. In Michigan, according to Winch-

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ell, in accumulations of marl and peat are found the remains of the elephant, Mastodon and elk. A fragment of the molar of a Mastodon was found at Green Oak, Livingston county. Mr. Shattuck has exhumed nearly an entire set of Mastodon teeth, including a piece of a tusk in Plymouth, Wayne county. The teeth are all perfect and still retaining their glossy enamel and most of the fangs pertaining to molar teeth.

A nearly perfect skeleton of a Mastodon was exhumed near Bucyrus in Crawford county, Ohio, many years ago from the muck and marl of a swamp, and is now in possession of the Ohio Agricultural and Mechanical College. The "Erie clay" is the lower drift near the lakes, and is sometimes as much as 280 feet thick. Above it lies the "Delta sand," separated about Cleveland from the Erie clay by one to two feet of carbonaceous matter with trunks of trees. This "forest bed," as it is called by Prof. Newberry, extends through a large part of Ohio and into many other of the Western states; traces of it exist in Illinois, Missouri and Nebraska. Prof. Newberry informs us that the Delta sand deposit near Cleveland has yielded numerous portions of the skeleton of the elephant and Mastodon. In other parts of Ohio they are found in the forest bed, and in the overlying drift and in the recent peat marshes.

Remains of the Mastodon are found in the post glacial beds of the Maumee valley. Part of a skeleton was obtained from a peat swamp near St. Johns, Au;laize county, The appearances indicate that the animal had mired and died where found. Prof. Gilbert carefully examined the locality and was confirmed in this opinion; also that the animal lived and died after the deposition of the drift, and that the overlying peat had since been formed. The depth of the swamp is eight feet, of which the upper one-third is peat.

Passing to the Pacific slope, Whitney informs us of the occurrence near Benicia, California, of a Post-Tertiary deposit made up of beds of gravel, sand, clay and oyster shells, and containing fragments of bones of large animals and rolled Tertiary shells. At Bottle Hill, near Benicia, these beds contain boulders of gray sandstone, also bones of the Mastodon and horse. In the Gaviota pass, in the superficial detritus at the bottom of a layer of clay four feet thick and resting on sand, were found Mastodon bones. In Tuolumne county, on the southern bank of the Stanislaus, there is a vast accumulation of calcareous tufa which assumes a most picturesque appearance, sometimes rising in cliffs like coral reefs. In this deposit are found many fragments of mammalian bones, including the Mastodon, Elephant and horse; also both land and fresh water shells All through the region northwest of Columbia, as far as Abby's ferry, the remains of the elephant and Mastodon are very abundant.

Quoting from Whitney's Geology of California, he says: Among the animals of the Pliocene we recognize the rhinoceros, a species of horse, an animal resembling the camel and one resembling the hippopotamus, and they are peculiar to the deposits under the lava. The lava flow destroyed them. After that was the Post Pliocene epoch appearing on the foot hills and slopes of the Sierra. This

passes gradually into that of the present day, or the recent. Prominent among the animals of that time were the Mastodon and elephant, whose remains are found in the detritus of the gold region. Associated with them were the tapir, the bison and the horse—two species—one of them scarcely distinguishable from the present mustang.

From the Tertiary of North America Prof. Leidy names three species, including the South American species *Mastodon andium*, also found in Central America, *M. mirificus* in the Pliocene of the Loup fork of Nebraska.

The *M. obscurus* was first noticed from the Miocene of Maryland.

Dr. Lorenzo G. Yates, of Centreville, Cal., has discovered a number of Mastodons in California which are referred to this species, notably the lower jaw and upper molar at Oak Springs, Contra Costa county, Cal., in the Pliocene Tertiary; the fragment of a tusk from Stanislaus county.

Remains of this species from near Santa Fe, New Mexico, are found associated with *Elephas americanus*, the cancellated structure of the bones filled with crystalline Calcite. The *M. mirificus* has been obtained from Sinker creek, Idaho, and the Niobrara, Nebraska.

Von Meyer describes the jaw of a Mastodon from Michvasan, Mexico, as M. *humboldtii*, but Prof. Leidy thinks this must be *M. obscurus*. We thus find that the Mastodon first appeared in America in Miocene times; was abundant in the Pliocene, and lingered until the close of the Glacial period and disappeared in the early Loess. We also find that he roamed at will, from Canada to South America, being found as far North as 66° N. Lat. on our Western coast; and either entire skeletons or portions have been found in nearly every State and in some of the Territories. The *M. arvernensis* has been found in the Pliocene of England, (Red Crag,) associated with the *Hippopotamus major*; in Val d'Arno, in Piedmont and Montpelier. The M. *angustidens* is from the Miocene of Lonans, of Touraine, and from Gers, near the base of the Pyrenees, associated with *Dinotherium*. Mastodons have been found in the Miocene of Switzerland, of Greece and *M. longirostris* is found at Vienna, associated with *Dinotherium*, *Rhinoceros*, etc.

Humboldt discovered the tooth of a Mastodon near the volcano of Imbaburra, at an elevation of 7200 feet. Mantell informs us that the Turquois of Simone are composed of mammoth bones, impregnated with a metallic oxide.

A species named *M. elephantoides* was obtained by Mr. Cranford from the banks of the Irrawaddi in the Birman Empire. The bones were here invested with a hard calcareo-silicious conglomerate.

In the foot-hills of the Himalayas the bones of a Mastodon are found associated with those of seven species of the elephant, four of hippopotamus, five species of rhinoceros, three of horse, elk, camel, giraffe, sheep and the wonderful Sivatherium. There is also here found an ostrich, an ox and a tortoise with a shell twelve feet in length. The Sewalik hills where these are found, rise 2000 to 3000 feet above the sea, and contain the most remarkable deposits of Miocene animals in the world. The *Elephas Ganesi* here found have tusks ten and a half feet long.

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and twenty-six inches in circumference at the base.

A species of Mastodon, related to *M. augustidens* has left its remains in the ossiferous caves of Australia and probably the same species has been found in Peru.

Nicholson's Paleontology pp. 442 gives order *Proboscidea* including three genera *Elephas*, *Dinotherium* and *Mastodon*, characterized by total absence of canine teeth, few molar teeth, large and transversely ribbed or tuberculate; incisors always present and grow from persistent pulps, constituting long tusks. In all the elephants there are two of these tusks like incisors in the upper jaw, the lower jaw without incisor teeth. In the *Dinotherium* this is reversed, being two tusk-like lower incisors and no upper incisors. In the *Mastodon* the incisors are usually developed in the upper jaw and form tusks as in the elephant; but sometimes there are upper and lower incisors movable in every direction, highly sensitive and terminating in a finger-like prehensile lobe. The nostrils are placed at the extremity of the proboscis. The feet are furnished with five toes each, but these are only partly indicated externally by the divisions of the hoof. The feet are furnished with a thick pad or integument, forming the palms of the hand and the soles of the feet. There are no clavicles and the tusks are abdominal through life. There are two teats, and these are placed upon the chest.

In the elephant whether living or extinct, the tusks are formed by an enormous development of upper incisors. The milk-tusks are early shed and never attain a great size. The permanent teeth, however, grow from persistent pulps attaining an enormous size in old males. The lower incisors are absent and there are no other teeth in the jaws except the large molars, which are usually two in number, on each side of the jaw. The molar teeth are of very large size and are composed of a number of transverse plates of enamel, united by dentine. The surfaces of the molars are approximately flat. There are six species of *Elephas* in the Miocene of Asia. The *Elephas antiquus* is a southern form of Pliocene age. The *Elephas primigenius* is a northern form of Post-pliocene age, and is the hairy mammoth occurring in Siberia in Northern Europe and the northern portion of North America. It did not occur, (according to Dawkins,) South of a line passing through the Pyrenees, the Alps, northern shores of the Caspian, Lake Baikal and Kamschatka. It survived the Glacial period and is found abundantly in Post-glacial deposits of France, Germany, Britain, Russia in Europe, Asia and North America. It survived into the earlier portion of the human period, its remains being found in a great number of instances associated with implements of human manufacture; while in one instance a recognizable portrait of it has been discovered, carved on bone.

The *Elephas Malitensis* of Malta was scarcely four and a half feet high; another the *E. falconeri* was still smaller, being two and a half to three feet.

But little was known of the *Dinotherium*, only found in the Miocene. Its skull was enormous, the molars and pre-molars were present in each jaw, the upper jaw destitute of canine and incisors. In the lower jaw were two long tusk-like incisors bent downward like hooks.

The Mastodons in most respects closely resemble the true elephants, from which they are distinguished by their dentition. As in the elephants the upper incisors grow from prominent pulps and constitute long tusks; but in the majority of cases the Mastodons also possess lower incisors as well. The lower incisors, however, though tusk-shaped, did not develop themselves to any extent, and often disappeared in adult life. A more important distinction between the elephants and Mastodons is, that the molar teeth of the latter are not only more numerous, but have the peculiarity that their crowns are furnished with nipple-shaped eminences or tubercles placed in pairs, (its name derived from the Greek *Mastos*, a teat, and *odous* a tooth).

In the Mastodon the dentine or principal substance of the tooth is covered by a very thick coat of dense and brittle enamel, a thin coat of cement is continued from the fangs upon the crown of the tooth, but this third substance does not fill up the inter-spaces of the division of the crown as in the elephant's grinder.

In the *M. ohioticus* (*M. americanus*) the lower jaw has two tusks in the young of both sexes; these are soon shed in the female, but one of them is retained in the male. The upper tusks are long and retained in both sexes. The Mastodons were elephants with the grinding teeth less complex in structure and adapted for bruising tender and coarser vegetable substances, roots and aquatic plants. The large eminences of the grinding teeth, the unusual thickness of the enamel and almost entire absence of the softer cement from the grinding surface of the crown would indicate their adaptation to crushing harder and coarser substances than the more complex but weaker teeth of the elephant. Their limbs are proportionally shorter than the elephant though constructed on the same type, but the leg bones are stronger, cranium flatter, and from the smaller development of the frontal air cells, it presents a less intelligent character.

Other Mastodon remains discovered in Asia present the transitional character of the teeth of the elephant and the Mastodon. For the Mastodons with three-ridged penultimate and ante-penultimate grinders, Dr. Falconer proposed the name *Trilophodon*. The species *Mastodon americanus* of Cuvier was described in 1798; *M. ohioticus* in 1799; *M. giganteus* in 1817. Both the latter are the *M. americanus* Cuvier, which is the proper name by priority.

The *Mastodon* first appeared in the Miocene, being there represented by four European and three Indian species; occurring also in the Pliocene and Post-Pliocene.

The Mastodon bones first found were supposed to be the same as the Siberian Mammoth. He was called the "Big Buffalo" by the Indians, and they had traditions of his former life here. In Jefferson's Notes on Virginia a Delaware chief informed the Governor of Virginia "that in ancient times a herd of these tremendous animals came to the Big-Bone licks, and began a universal destruction of the bear, deer, elks, buffaloes and other animals which had been created for the use of the Indians; that the Great Man above, looking down and seeing this, was so enraged that he seized his lightning, descended on the earth, seated

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himself on a neighboring mountain, on a rock on which his seat and the print of his feet are still to be seen, and hurled his bolts among them till the whole were slaughtered, except the Big Bull, who, presenting his forehead to the shafts, shook them off as they fell; but missing one at length, it wounded him in the side; whereon springing round, he bounded over the Ohio, over the Wabash, the Illinois, and finally over the great lakes, where he is living at this day."

THE ANTIQUITY OF MAN AND THE ORIGIN OF SPECIES.

BY PRINCIPAL J. W. DAWSON, MONTREAL, P. Q.

Among the numerous books and articles constantly inviting the attention of readers to the subjects of evolution and the antiquity and origin of man, some are rather of an argumentative and polemical character than of the nature of original investigation; others relate to new facts, and constitute actual contributions to the data of questions as yet too scantily supplied with fundamental truths. Of the former class many are interesting, able, and suggestive; but it is on work of the second class that the actual settlement of these disputes must depend, though in the meantime this may be comparatively unknown to the general reader, whose ideas as to the present state of these questions are likely to be derived rather from the confident assertions and well-put arguments of popular writers than from the more solid though less showy and far less startling and less assured conclusions of actual painstaking work.

Of works which may claim to contain results of original and useful investigation, the following, which are now in the hands of scientific men and embrace a very wide range of inquiry, may afford the material for profitable discussion in this REVIEW: Dawkins on "Early Man in Britain" is a work limited in its range, but embracing the results of the investigations of an acute observer, well up in the paleontology of the more recent formations. Barrande's "Brachiopods," extracted from the great work on the Silurian System of Bohemia, is the production of the first paleozoic paleontologist of our age, and with regard to the group to which it relates, as well as to the cephalopods and trilobites previously treated by the author in the same manner, is an exhaustive inquiry as to what they have to say for and against evolution. "Les Enchaînements du Monde Animal," by Gaudry, may be regarded as a popular book; but it is the work of one of the most successful collectors and expositors of the Tertiary mammalia. "Le Monde des Plantes," by Saporta, is also in some degree popular in its scope, but is replete with scientific facts admirably put together by a most successful and able paleo-botanist. Of the above writers Barrande is an uncompromising opponent of evolution as ordinarily held. In other words, he finds that the facts of the history of life in the Paleozoic period lend no countenance to this hypothesis. The others are theistic evolutionists, holding the doctrine of derivation with more or less of modification, but not descending to the special pleading and one-

sided presentation of facts so common with the more advanced advocates of the doctrine. Perhaps we may most clearly present the salient points brought out in these works by noticing first the successive Tertiary periods and their life, culminating in the introduction of man, and secondly the facts as to the introduction of those earlier creatures which swarmed in the Paleozoic seas.

The Tertiary or Kainozoic period, the last of the four great "times" into which the earth's geological history is usually divided, and that to which man and the mammalia belong, was ingeniously subdivided by Lyell, on the ground of percentages of marine shells and other invertebrates of the sea. According to this method, which with some modification in details is still accepted, the *Eocene*, or dawn of the recent, includes those formations in which the percentage of modern species of marine animals does not exceed 3½, all the other species found being extinct. The *Miocene* (less recent) includes formations in which the percentage of living species does not exceed 35, and the *Pliocene* (more recent) contains formations having more than 35 per cent of recent species. To these three may be added the *Pleistocene*, in which the great majority of the species are recent, and the *Modern*, in which all may be said to be living. Dawkins and Gaudry give us a division substantially the same with Lyell's, except that they prefer to take the evidence of the higher animals instead of the marine shells. The Eocene thus includes those formations in which there are remains of mammals or ordinary land quadrupeds, but none of these belong to recent species or genera, though they may be included in the same families and orders with the recent mammals. This is a most important fact, as we shall see, and the only exception to it is that Gaudry and others hold that a few living genera, as those of the dog, civet, and marten, are actually found in the later Eocene. In the case of plants, as we shall find, Saporta shows that modern genera of land plants occur before the Eocene, in the last great group of the preceding period, and we have abundant American evidence of the same fact. As in the Mosaic narrative of creation, the higher plants precede by a long time the higher animals. The Miocene, on the same mammalian evidence, will include formations in which there are living genera of mammals, but no species which survive to the present time. The Pliocene and Pleistocene show living species, though in the former these are very few and exceptional, while in the latter they become the majority.

With regard to the geological antiquity of man no geologist expects to find any human remains in beds older than the Tertiary, because in the older periods the conditions of the world do not seem to have been suitable to man, and because in these periods no animals nearly akin to man are known. On entering into the Eocene Tertiary we fail in like manner to find any human remains; and and we do not expect to find any, because no living species and scarcely any living genera of mammals are known in the Eocene; nor do we find in it remains of any of the animals, as the anthropoid apes for instance, most nearly allied to man. In the Miocene the case is somewhat different. Here we have living gen-

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era at least, and we have large species of apes; but no remains of man have been discovered, if we except some splinters of flint found in beds of this age at Thenay in France, and a notched rib-bone. Supposing these objects to have been chipped or notched by animals, which is by no means certain or even likely, the question remains, was this done by man? Gaudry and Dawkins prefer to suppose that the artificer was one of the anthropoid apes of the period. It is true that no apes are known to do such work now; but then other animals, as beavers and birds, are artificers, and some extinct animals were of higher powers than their modern representatives. But if there were Miocene apes which chipped flints and cut bones, this would, either on the hypothesis of evolution or that of creation by law, render the occurrence of man still less likely than if there were no such apes. For these reasons neither Dawkins nor Gaudry, nor indeed any geologists of authority in the Tertiary fauna, believe in Miocene man.

In the Pliocene, as Dawkins points out, though the facies of the mammalian fauna of Europe becomes more modern and a few modern species occur, the climate becomes colder, and in consequence the apes disappear, so that the chances of finding fossil men are lessened rather than increased in so far as the temperate regions are concerned. In Italy, however, Capellini has described a skull, an implement, and a notched bone supposed to have come from Pliocene beds. To this Dawkins objects that the skull and the implement are of recent type, and probably mixed with the Pliocene stuff by some slip of the ground. As the writer has elsewhere pointed out,* similar and apparently fatal objections apply to the skull and implements alleged to have been found in Pliocene gravels in California. Dawkins further informs us that in the Italian Pliocene beds, supposed to hold remains of man, of twenty-one mammalia whose bones occur, all are extinct species except possibly one, a hippopotamus. This of course renders very unlikely in a geological point of view the occurrence of human remains in these beds.

In the Pleistocene deposits of Europe—and this applies also to America—we for the first time find a predominance of recent species of land animals. Here, therefore, we may look with some hope for remains of man and his works, and here, according to Dawkins, in the later Pleistocene they are actually found. When we speak, however, of Pleistocene man, there arise some questions as to the classification of the deposits, which it seems to the writer Dawkins and other British geologists have not answered in accordance with geological facts, and a misunderstanding as to which may lead to serious error. This will be best understood by presenting the arrangement adopted by Dawkins with a few explanatory notes, and then pointing out its defects. The following may be stated to be his classification of the later Tertiary:

I. PLEISTOCENE PERIOD: the fourth epoch of the Tertiary, in which living species of mammals are more abundant than the extinct, and man appears. It may be divided into—

* "Fossil Men," 1880.

(*a*) *Early Pleistocene*, in which the European land was more elevated and extensive than at present (First Continental Period of Lyell), and in which Europe was colonized by animals suitable to a temperate climate. No good evidence of the presence of man.

(*b*) *Mid Pleistocene*. In this period there was a great extension of cold climate and glaciers over Europe, and mammals of arctic species began to replace those previously existing. There was also a great subsidence of the land, finally reducing Europe to a group of islands in a cold sea, often ice-laden. Two flint flakes found in brick earth at Crayford and Erith in England are the only known evidences of man at this period.

(*c*) *Late Pleistocene*. The land was again elevated, so that Great Britain and Ireland were united to each other and to the continent (Second Continental Period of Lyell). The ice and cold diminished. Modern land animals largely predominate, though there are several species now extinct. Undoubted evidences of man of the so-called "Paleolithic race," "Riverdrift and Cave men," "Men of the Mammoth and Reindeer periods."

II. PREHISTORIC PERIOD: In which domestic animals and cultivated fruits appear; the land of Europe shrinks to its present dimensions. Man abounds, and is similar to races still extant in Europe. Men of "Neolithic age," "Bronze age," "Prehistoric Iron age."

III. HISTORIC PERIOD: In which events are recorded in history.

I have given this classification fully, in order to point out in the first place certain serious defects in its latter portion, and in the second place what it actually shows as to the appearance of man in Europe.

In point of logical arrangement, and especially of geological classification, the two last periods are decidedly objectionable. Even in Europe the historic age of the south is altogether a different thing from that of the north, and to speak of the prehistoric period in Greece and in Britain or Norway as indicating the same portion of time is altogether illusory. Hence a large portion of the discussion of this subject has to be called by our author "the overlap of history." Further, the mere accident of the presence or absence of historical documents cannot constitute a geological period comparable with such periods as the Pleistocene and Pliocene, and the assumption of such a criterion of time merely confuses our ideas. On the one hand, while the whole Tertiary or Kainozoic, up to the present day, is one great geological period, characterized by a continuous though gradually changing fauna and series of physical conditions, and there is consequently no good basis for setting apart, as some geologists do, a Quarternary as distinct from the Tertiary period; on the other hand there is a distinct physical break between the Pleistocene and the Modern in the great glacial age. This in its arctic climate and enormous submergence of the land, though it did not exterminate the fauna of the Northern Hemisphere, greatly reduced it, and at the close of this age many new forms came in. For this reason the division should be made not where Dawkins makes it, but at or about the end of his "Mid Pleistocene." The natural division would thus be:

I. PLEISTOCENE, including—

(*a*) *Early Pleistocene*, or First Continental period. Land very extensive, moderate climate.

(*b*) *Later Pleistocene*, or glacial, including Dawkins' "Mid Pleistocene." In this there was a great prevalence of cold and glacial conditions, and a great submergence of the northern land.

II. MODERN, or Period of Man and Modern Mammals, including—

(*a*) *Post-glacial*, or Second Continental period, in which the land was again very extensive, and Paleocosmic man was contemporary with some great mammals, as the mammoth, now extinct, and the area of land in the Northern Hemisphere was greater than at present. This represents the Late Pleistocene of Dawkins. It was terminated by a great and very general subsidence accompanied by the disappearance of Paleocosmic man and some large mammalia, and which may be identical with the historical deluge.

(*b*) *Recent*, when the continents attained their present levels, existing races of men colonized Europe, and living species of mammals. This includes both the Prehistoric and Historic periods.

On geological grounds the above should clearly be our arrangement, though of course there need be no objection to such other subdivisions as historians and antiquarians may find desirable for their purposes. On this classification *the earliest certain indications of the presence of man in Europe, Asia, or America, so far as yet known, belong to the Modern period alone.* That man may have existed previously no one need deny, but no one can positively affirm it on any ground of actual fact. I do not reckon here the two flint flakes of Crayford and Erith already mentioned, because even if they are of human workmanship, the actual age of the bed in which they occur, as to its being glacial or post-glacial, is not beyond doubt. Flint flakes or even flint chips may be safely referred to man when they are found with human remains, but when found alone they are by no means certain evidence. The clays of the Thames valley have been held by some good geologists to be pre-glacial, but by others to be much later, and the question is still under discussion. Dawkins thinks they may be "Mid Pleistocene," equivalent to "Later Pleistocene" of the second table above, and that they are the oldest traces of man certainly known, but in the mean time they should evidently be put to what has been called "the suspense account."

Inasmuch, however, as the human remains of the post-glacial epoch are those of fully developed men of high type, it may be said, and has often been said, that man in some lower stage of development *must* have existed at a far earlier period. That is, he must if certain theories as to his evolution from lower animals are to be sustained. This, however, is not a mode of reasoning in accordance with the methods of science. When facts fail to sustain certain theories we are usually in the habit of saying "so much the worse for the theories," not "so much the worse for the facts," or at least we claim the right to hold our judgment in suspense till some confirmatory facts are forthcoming.

Before leaving this part of the subject it may be well to remark the grand procession of mammalian life, beginning with the marsupial and semi-marsupial beasts of prey and low-browed and small-brained but gigantic ungulates of the Eocene, and ending with man. There is here unquestionable elevation in rank, by whatever means effected. Gaudry inclines to some form of evolution, though

he piously refers it to the operation of the Creator. He thinks he can see traces of such evolution in the carnivorous animals, as derived from marsupials, and in the antelope and deer tribe, more especially in the development of horn and antler; and he traces the horse through a supposed ancestry of hipparia, etc., differing, however, from English and American evolutionists in making the *Paleotherium* the initial link. This is, however, a matter of taste, as these genealogies may usually be traced with equal probability or improbability through any one of half a dozen lines. But in the case of some groups of animals, and these of the highest importance, he freely admits that derivation is at fault. The elephants and their allies the deinotheres and mastodons, for example, appear all at once in the Miocene period and in many countries, and they only dwindle in magnitude and numbers as they approach the modern. Gaudry frankly says: "D'où sont-ils venus, de quels quadrupèdes ont-ils été dérivés? Nous l'ignorons encore." The edentates, the rodents, the bats, the manatees are equally mysterious, and so are the cetaceans, those great mammalian monsters of the deep, which leap into existence in grand and highly developed forms in the Eocene, and which surely should have left some trace of their previous development in the sea. "We have," says Gaudry, "questioned these strange and gigantic sovereigns of the Tertiary oceans as to their progenitors, but they leave us without reply," and he goes on to refer to several things in connection with their habitat, their reproduction, and their dentition or want of it, which make their sudden appearance still more inscrutable. It is refreshing to find a naturalist who, while honestly and even enthusiastically seeking to establish the derivation of animals, gives due prominence to the facts which, in the present state of knowledge at least, refuse to be explained by his theory. The reader may note here that the appearance of man fully developed in the Modern period is parallel with that of the elephantine animals in the Miocene and the whales in the Eocene, as well as with a vast multitude of other cases which meet the paleontologists in every direction.

In the world of plants, Sarporta has a strangely different story to tell, though its general plan evidently harmonizes with the history of mammalian life. If we keep out of view the few species of small marsupials that exist in the Mesozoic period, mammalian life in all its grandeur comes into existence at a bound in the Eocene. But it had been preceded for at least one great geological period by a vegetation similar to that now living. It can scarcely be questioned that the vegetation of the older geological periods, however rank and abundant, was not well suited to sustain the higher herbivorous animals. Accordingly, no such animals are known in these periods. But in the cretaceous age we find in the lower beds of that series some coniferous plants of living genera, and in the upper cretaceous modern generic forms come in, both in Europe and America, in great force. We have magnolias, oaks, beeches, ivies, ginsengs, plane-trees, poplars, palms, and a host of familiar forms, and some of these so closely resembling existing species that it scarcely requires the eyes of an evolutionist to see in them the ancestors of our modern trees. Thus an ample and long-continued preparation was made not

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only for the introduction of mammalian life, but even for giving to the landscape its existing features. It seems indeed strange that no precursors of the Eocene mammals have yet been found in connection with these plant remains of the newer cretaceous. There is a gap here in animal life which we may expect at some time to be filled. There seems, however, notwithstanding the great changes in climate and physical geography, to have been much less change from the cretaceous onward in the plant world than in the world of higher animal life, so that Saporta can figure series of leaves of plants of modern genera from the Eocene upward, showing so little modification that they may in some cases be regarded as scarcely more than varietal forms, while some of the species have undoubtedly survived without change through all the long ages extending from the beginning of the Kainozoic to the present day. Plant-life is in this analogous to the lower animal life of the sea, which presents the same unchanged characteristics in Eocene and Modern species.

(*To be continued.*)

ARTESIAN WELLS IN COLORADO.

CAPT. E. L. BERTHOUD.

An artesian well is one that is sunk through an inclined stratum of rock or clay, or slate impervious to water, to more porous or pervious strata underneath. Hence, unless we have inclined strata, or those inclined qua-quaversally, thus forming boat-shaped or saucer-shaped depressions, we cannot hope to succeed in sinking an artesian or water pressure well.

The increasing volume of population that is surging west of the Missouri river into what Professor Powell justly calls the arid regions of the United States, and the increasing and imperative demand that this swelling tide has for an abundant and perennial supply of water, is one that justly demands immediate and paramount attention on the part of State, local, and (above all) general government authorities.

It is not the design here to enter into any details of where and how we must or do use water, but simply to discuss the subject of water supply in its various forms as evident to us—the causes that affect its volume and distribution, and the methods that in future may be used to enhance its supply and to render desert wastes habitable and of economic value.

Prominently before the people of Colorado is Senator Hill's appropriation (for to his efforts this is mainly due) that has been made for the purpose of sinking artesian wells in Colorado, as a trial experiment.

We will not in this sketch pretend to criticise the action of the "experts" who have decided upon the localities where our wells are to be sunk—nor do we design these remarks in any unfair spirit of criticism. The gentlemen, who have for the department in Washington the care and responsibility of this work, must

have a fair chance to carry out their theories and ideas—they have publicly announced them, and until their failure or success proves them right or wrong, it is not fair to find fault. But while anxiously awaiting the final result that their borings will develop, we will examine the question of such wells in the abstract, and discuss not only the origin of the underground supplies of water we may expect to reach in Colorado, east of the main mass of the Rocky Mountains, but the constant proportion that the subterranean supply of water bears to the total meteoric supply—the amount that is carried out into the open plains country by evaporation and the streams, and lastly the topographical and geological features, favorable or unfavorable, to the project of a water supply from artesian wells.

Originally, we conceive that as late as the lower Eocene or upper Cretaceous ages, the whole region between the South Platte and Wahsatch Mountains was then an undulating surface, unbroken by any mountain range. The Rocky Mountains were then elevated, and on their flanks to the east and from the central range westward to the great basin the cretaceous strata were tilted and uplifted in great confusion. This continuous movement of elevation raised up on the east foot-hills into the jurassic and triassic and carboniferous strata existing underneath the Cretaceous, so that we can to-day walk over and examine each outcrop from the Eocene to the Carboniferous without difficulty, and each lying in a highly inclined position from the thirty-fifth to the seventieth dip.

Most prominent among the successive outcrops that we find parallel to, and continuous from the North Platte to the Spanish peaks, are the various high picturesque ridges of cretaceous sandstones and slates that like vast waves follow the contour of the granite and mica slate foot-hills, whose elevation originally disturbed their normal level with the most recent Cretaceous—or we might better say at the *point of passage* from the upper Cretaceous to the lower Eocene we find a series of formations, essentially fresh water, or estuary too in part, in which are developed a large succession of coal veins, accompanied with a large development of fire-clay and potters-clay beds, and finally overspread with a very thick deposit of green Tertiary clay, lying uncomformably upon the coal measures.

Now the inclination of the successive strata from the metamorphic eastward to the tertiary is excessive, and the ends of the strata form the general surface of the ground in the valleys and the foot-hills, each branch or affluent of the Platte cutting a bed through the upturned strata until it reaches the more horizontal formations that constitute the Missouri and Platte river prairies, while a large portion of the water that comes from the central range in the shape of melted snow or summer rains is taken up and stopped by the more porous and open sandstone strata that form the beds of the streams when they leave the mountain cañons on their way to the South Platte, the North Platte, and the Arkansas. This amount of water from the streams whose supply comes from the central range, joined to that which, as melted snow and as rain, is taken up and absorbed all over the foot ranges of our mountains, finally reaches our porous sedimentary strata at the foot of the mountains, and follows down their fissures and faults until they either reach the impenetrable fire-clay walls of our coal formation, or

else the great clay deposit overlying the coal, and east of the coal veins, either of these clay deposits being sufficient to arrest the outward flow of the drainage of our mountain range, thus acting as an impervious wall or dam, and forcing into the low-lying porous strata, under the clay, a vast volume of water, which is totally lost for any available purpose. It is evident, however, that in Jefferson and Boulder counties, where the coal formation is extensively developed, that the amount of water absorbed and which passes under the great clay deposit that overlies the coal, is of very small volume compared to that which is stopped by the fire clay beds in the coal deposits against whose face the whole mountain drainage is finally accumulated, and which it follows to an almost unknown depth.

We have been, perhaps, too particular in our local remarks touching the sequence of our geological deposits, and their situation in respect to the configuration and drainage of our mountain range, and its outliers to the East, formed of sedimentary rocks, but we consider these details as absolute, not only in general accuracy, but as necessary to develop the theory we have formed, based on their sequence and position.

In accordance, then, with the preceding description of the geological and lithological formation of the strata adjacent to the Rocky Mountains, between the thirty-eighth and forty-first degrees of latitude, we believe to make the boring of an artesian well a success, that we must select a point for that undertaking immediately east of the outcrop of the coal formation, or failing to find and identify in any one spot the presence of the great lignite beds bordering the foot-hills, we must sink down through the great green clay deposit that overlies this formation, until we reach the sandstone strata beneath it. For whenever the vertical boring in the coal formation reaches the sandstone and slates beneath the coal, we will find abundant supplies of water derived from the higher lands west of them. The same, but in a lessened degree, will be the case when we bore the great tertiary clay deposit overlying the coal measures unconformably.

Now it has been shown from the result of the artesian well borings made by Captain Pope in the *Llano Estacado* and also in New Mexico—by the borings made near Carson, in Arapahoe county, and also by one or two attempts made between the South Platte and the foot-hills near Golden—that although water was found in boring down in every instance, yet it signally *failed to reach the surface* by hydrostatic pressure. We believe this is due to two causes:

1. That until such borings have been extended downward sufficiently to reach either the Tertiary clay, or cretaceous coal shales or clays, the fillets of water that are found are due either to local drainage, or—

2. They are obtained from the scattered crevices or cleavage planes existing everywhere in the porous sandstone and slates underlying the whole region embraced in our remarks—and that this universal diffusion of small underground veins, not derived from the higher mountains to the west, is the reason of their failure to reach the surface, or to overflow above it.

We need not here allude to the well-known fact of the scarcity of springs

everywhere in the prairie region of Colorado, and to their comparatively reduced numbers everywhere in the foot-hills, where we find the upturned "hog-backs" are formed of sandstone, limestone or slate, while we find them always beyond the upturned coal measures.

The writer of this article was the witness, some eighteen years ago, of an effort made by the war department to obtain water near Fort Lyon for the quartermaster's herd, north of the Arkansas river. A well was dug some thirty feet in tenacious clay, then borings were carried on some thirty or forty feet deeper. The clay continued the same at the farthest depth attained, but not one drop of water was obtained, and the effort was given up as wholly useless, although begun in the bed of a dry affluent of the Arkansas.

To make an artesian well practically and fully useful, we must draw from the underground resources that are derived from our vast mountain ranges. The local rainfalls of the great plains west of 100 degrees west longitude are too scanty in amount to ever be of much practical benefit, the rapid slope of the plains and the excessive evaporation from their treeless surfaces rendering that supply precarious and the effect of but short duration. The effect of hard rain in this part of Colorado is to drain away rapidly into the Arkansas, Smoky Hill and Republican rivers, by the numerous dry ravines that radiate from those rivers. Their waters rise very high in a few hours, the water drains rapidly away, but its retention on the surface is very light in amount from the scanty nature of the herbage clothing the ever parched prairies.

From observations taken at Fort Sedgwick, Fort Russell, Cheyenne, Denver, Fort Reynolds and Fort Lyon, on the Arkansas, the yearly rain fall will average over that region about 13.21 inches.

The average along the Colorado foot-hills is about 17.30 inches.

The average for Clear Creek valley in the mountains, as far as Georgetown, Bakerville, Black Hawk and Central, is about 18.75 inches.

The rain fall and melted snow for the higher points above these, including the central range, will give yearly an approximate amount of 31.50 inches; or for the whole area of Clear Creek valley west of the range line, between ranges 69 and 70 west, amounting to about 400 square miles, we have a mean approximate amount yearly of rain and melted snow of 20.62 inches.

This gives us then for the Clear Creek water shed of 400 square miles a yearly amount of 19,068,800,000 cubic feet of water.

Now Clear Creek gives us from a series of measurements begun in September, 1860, and extended to March, 1880, an average discharge at Golden, Colorado, of 5,850,000,000 cubic feet per year. This amount, subtracted from 19,068,800,000, gives us 13,213,300,000 cubic feet of water that is lost to us by evaporation, or which, settling into the ground, is practically lost, unless sought for by digging, or returned to us through artesian wells in the foot-hills.

In other words, of all the rain and snow-fall received in the Clear Creek water-shed sixty-eight per cent. is lost to us and thirty-two per cent. is discharged by Clear Creek where it enters the plains.

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Hence for Denver and South Platte valley, of the 13.77 inches rainfall at Denver, 9.37 inches of water are lost by evaporation, or sinks into the ground.

At Cheyenne 6.9 inches are accounted for in the same way, from a yearly fall of 10.14 inches.

At Fort Lyon, on the Arkansas river, the yearly rain and melted snow is 12.50 inches, of which 8.54 inches are lost from the same causes.

Basing the above figures on the same percentage as Clear Creek valley, we are inclined to believe that the chances of obtaining subterranean supplies of water from artesian wells are *inversely* proportioned to their distance from the mountain range, and that the great diminution of rainfall from the main range eastward, already so much noted at Denver, is still more apparent as we go toward 102 and 101 degrees of west longitude in the Platte and Arkansas valleys.

And that to attempt to bore for permanent supplies of water east of parallel 105, in Boulder, Jefferson, Arapahoe, Douglas, Bent or Larimer counties, will be infructious or unsatisfactory, and cannot, we believe, lead to the discovery and delivery of large, permanent supplies of water.

The figures given for the rainfall for Clear Creek valley, the supply of water, etc., etc., are solely from the writer's own data. For the outside localities they are obtained from the United States signal service office, Smithsonian Institute, Prof. Powell's "Arid Regions," etc.

THE MIOCENE BEDS OF THE JOHN DAY RIVER, OREGON.

CHARLES H. STERNBERG, ELLSWORTH, KANSAS.

These beds consist principally of clay, with here and there a stratum of green sandstone. They are often covered with a cherty clay rock, that has been subjected to a great heat. Twelve or fifteen hundred feet of lava cover the deposit, and in many places dykes run across the country and through the tertiary beds. Here the earth has cracked and poured out its oceans of lava, where these dikes are exposed; they resemble rows of cord wood, the basaltic columns lying horizontal. The clay beds are of various colors, red, green and yellow, with all the intermediate shades. These bright colors form a pleasing landscape, especially where the elements have worn the beds into Bad Land scenery, while above, rises escarpment after escarpment of basaltic columns. The distant summits are crowned with forests of pine. The rocks, as I have said, are chiefly clay, which have been softened on the surface by rain and frost into soft earth, into one sinks a foot or more. Beneath this the rock is solid and hard to work. Great numbers of concretions are scattered through the beds. They are from a few inches to several feet in diameter. In places these concretions are arranged in rows one above the other one hundred feet in height, and the bed looks as if the rock had been faced with mortar and cannon balls six inches in diameter stuck into it in regular rows. Through the clay beds are often found

vertical seams of carbonate of lime. The beds are hard to explore, as they are almost perpendicular, with here and there a narrow projecting shelf that gives a precarious foothold. Only persons who have had long experience in collecting, and who have enthusiasm enough to risk their lives for science, can hope to meet with success; otherwise they will go away with no specimens, or only fragments some friendly wash has carried to a level place. The beds differ from any that I have ever explored, and a day's climbing among them would convince any but an experienced collector that they were destitute of fossils. The amount of labor required to wrest from Dame Nature her hidden treasures is great, but she always rewards persistent effort. I have more than once explored a locality for two weeks without success, and then found a splendid specimen in the very ground I had gone over again and again.

For nine or ten years these beds have been explored, and each year an equally rich harvest has been gathered. The fossil remains are often in concretions with eye rim, or the point of a tooth, or small portion of some other bone exposed, and you can easily see how carefully one must look, when hardly one concretion in a thousand contains anything of value. Of course, the smaller the amount of the skull that is exposed, the more perfect will be the specimens imprisoned in the friendly concretion. In the two years I worked in these beds I found great numbers of perfect skulls and many more or less perfect skeletons of various mammals, and in all my explorations in the fossil beds of the Northwest I never found such perfect specimens. At one time I got a nearly perfect skeleton of a large mammal unfortunately the skull was missing. It proved to be a new species belonging to a new genus: Cope called it *boocherus humerosus*, on account of a huge projection on the humerus. It was as large as a rhinoceros, with great pillar like limbs.

One great trouble we found in collecting was the dazzling surface of the beds we had to examine, the eyes soon becoming tired. We often had the sensation of snow blindness: five hours constant looking was a good day's work. The most abundant fossil found was the *oreoclon*, or the extinct hog, as they closely resembled that family. Three or four species were discovered, some about the size of the Texas peccary, others as large as the wild boar of Europe. I have been enabled to furnish Professor Cope a number of perfect skeletons of this genus, as their anatomy is well made out. The animals found belong to tropical countries. The rhinocerous is quite common, three or more species, one has a horn on each side of the end of the nose. The *hipparion* and other ancestors of the horse are found. One peculiar new genus I discovered was an ancestor of the South American Llama; Cope calls it *Probotherium sternbergii*. Instead of there being but one metacarpal as on the Llama, there are two pressed closely together, and, reasoning from the evolution theory, we would expect this to be the case in the ancestor of the Llama, because, in the metacarpal of the Llama, there are two projecting articulations for the attachment of two toes, and from each articulation a medullary canal extends back the whole length of the bone.

XUM

Just as Darwin reasoned, that in the early history of the horse, it must have had three toes, and that the two splint bones were the rudiments of those toes. The Oregon beds prove Darwin to be right, as horses with three toes have been found.

Among the carnivora, over ten species of dogs and tigers were discovered. One large dog had terrible fangs, longer than a tiger's, that were sharply serrate edged like a shark's. Another peculiar species had a shoulder on the lower canine, against which the point of the upper struck. This large number of carnivorous beasts show that herbivora were abundant, which we found to be the case.

Although these beds have been explored a great many years, we found new species and a number of new genera. The first year I worked in the beds I got thirteen new species. They will all be described and figured in a work by Professor Cope on the Miocene of Oregon, to be published by the Government.

Among the gnawers or rodents great numbers of species were found, from a small mouse to a beaver. I found fossil bones bearing the marks of these little rodents' teeth.

Hard-shelled turtles were the only reptiles found: they varied in size from six inches in diameter to two feet. Fresh water *unios* and other shells were abundant. The miocene beds of Oregon extend over the greater part of the eastern part of the State. Only the John Day and Crooked river have been explored. Rich harvests await the future explorer.

CORRESPONDENCE.

SCIENCE LETTER FROM PARIS.

November 20, 1880.

M. Deherain, in studying the origin of carbon in plants, points out the fact, that the seed retains the larger part of its reserved food for the development of the leaves, to enable them to take in at the earliest period a supply of carbonic acid. But if the seed germinates in a sterile soil, the root will become immeasurably long, just as when a plant vegetates in obscurity, the stem lengthens out in search of light, at the expense of the leaves, which, deprived of lights, can perform no function. Chlorophyll, or the green coloring matter of plants, consists according to M. Frémy, of two different susbtances, yellow and green; chlorophyll proper, is a highly agatized body, as is evident from the vigor with which wheat or grass in certain parts of a field accidently overmanured, spring up in rank green tufts during spring. Place a plant of tobacco in a poor soil, the leaves will commence to turn yellow, but add a dose of nitrogenous manures, and they will rapidly become a deep green. Light, whether it proceed from the

sun or artificially, by means of electricity, is necessary for the production of chlorophyll; but M. Boehm has demonstrated by experiments on young pines, that unless a certain degree of temperature exists, the influence of the light will be next to nugatory. Chlorophyll does not allow all the rays of light to pass through its mass indifferently; some traverse it, but others are retained, absorbed, and extinguished. The intense action of sunlight, if prolonged, induces a partial decoloration of the leaves, for the chlorophyll cells, which ordinarily run together like a string of beads, coalesce and seek the edges of the leaf as if for shade from the too powerful solar action. The chlorophyll cells are the seat of one of the most important phenomena of vegetation; it is therein where takes place the decomposition of carbonic acid; it is by that intermediary that vegetation receives and augments its mass of carbonaceous matter. The air is the grand source of carbon; for example, the immense regions of sandy soil in the southwestern and northern shores of France are barren of carbon, yet pine forests flourish there not the less. The carbon comes from the air, similarly as Boussingault caused plants to grow in sterile sand by merely keeping the roots in contact with water. Priestly in 1771 demonstrated, that an atmosphere in which a candle became extinguished, enabled a plant to exist, and later, when a second candle had been introduced, it burned as usual. The plant had absorbed and appropriated the carbon of the carbonic acid produced by the combustion of the first taper, giving off in return, oxygen to enable the second to burn. It was Housz, however, who showed that the leaves decomposed carbonic acid under the influence of light. If the living leaves be deprived, pending some days, of the action of air, or plunged for a relatively short time into an inert gas, they will become incapable to decompose carbonic acid—will perish—they are simply suffocated. Some substances, mercury for example, act on the leaves so as to render them incapable of decomposing the carbonid acid; they are literally paralyzed.

Cerebral always succeeds articulate rheumatism, and invariably terminates in death. When the disease gains the head, the pains in the articulations disappear. Rheumatism of the brain commences by delirium, continues by a succession of crises—ending in about twenty-four hours, and fatally—for the rare cases of cure do not count in the struggle. The highest medical authority in France, M. Woillez, asserts the affection of cerebral rheumatism can be successfully treated, and without danger to any other existing disease of the heart or lungs—that a patient may be suffering from, by means of cold immersions, in a bath reduced to sixty-eight degrees Fahr. by means of ice, maintaining the patient therein till the first symptoms of shivering appear. The bath is to be renewed every three hours, and generally three will suffice. It is vitally important to remember that on the first appearance of the symptoms medical aid should be called in, and action at once taken; each minute's delay is a chance removed for success. Nothing but immersion must be practiced, as nothing can replace the ice bath, neither local applications of ice, nor lotions, nor wet sheets. These are only

auxiliaries of the cold bath. As there is no uncertainty respecting the happy results, so there should be no hesitation to adopt the remedy. The time for the patient to remain in the bath, till the shivering sets in, may vary from ten minutes to one hour and a half. Sometimes the bath is *commenced* at eighty-six degrees Fahr., and cooled down to the sixty-eight and even sixty-four degrees. A bath at eighty-two degrees has occasionally sufficed to ward off the mortal symptoms, commencement of asphyxia. The delirium resulting from cerebral rheumatism manifests itself under the form of hallucinations, melancholy, stupor, persecution and total perversion of character, ending in coma; other symptoms are, sleeplessness, convulsions and tremblings, the last stage being asphyxia. No treatment in the history of medicine produces such prodigious results in so short a time, as immersion in the cold bath; it takes the patient in the moment of inert agony, deprived of all sentiment and reason, and in the twinkling of an eye, restores him to life. First, the danger imminent from asphyxia is conjured by respiration being established, the muscular tremblings are calmed and disappear. The delirium may not have departed—a circumstance not very important, as the primary point is attained—the living of the patient. Often the delirium will have vanished with the first bath, returning in the interval before the second; the pulse, after the bath, will have been found to have descended from 160 to 108. Pending the four or seven hours that may elapse after the bath, the patient will gradually become warm, experience a general sense of relief, then suddenly the temperature of the body will mount, but never will attain the number of degrees as before the immersion.

There is no physical theory about electricity. Neither Faraday nor Thompson attempted such; hence, why the question is being discussed. Is electricity a form of matter, or a form of force like heat and light? Clearly it must be either. Matter is all that can be perceived by the senses or put in movement be force; its properties are weight, inertia, elasticity. Force is all that which produces or tends to produce movement of matter either by pressure, tension, attraction or repulsion, so as to effect a change in the repose of matter or to modify its movement. Matter is represented by sixty-four elements, and which have up to the present resisted all means of analysis; it occupies space, and is to be met with under four forms, solid, liquid, gaseous and ultra gaseous; it is composed of molecules and atoms. An atom is the most tiny indivisible part of an element; a group of atoms of the same element, or of different elements, constitutes a molecule, and which has defined dimensions, and remains always invariably in its form for each substance. The *mass* of a substance is the reunion of the molecules of which it is composed Atoms can neither be created nor destroyed; hence, matter is indestructible. We can only form an approximate idea of the dimensions of a molecule. According to Sir W. Thompson, if a sphere of water, large as a pea, were magnified to equal the volume of the earth, each molecule proportionally augmented would be of a volume between the sizes of a small ball of lead and an ordinary cricket ball; fifty millions of molecules

placed in line, would extend to an inch. Molecules are very elastic, and when unopposed by obstacles, move rapidly and in a right line; when they move freely, they represent the *ultra gaseous* state of matter, as obtained by Crookes in almost a vacuum; when they knock against each other, following the law of elastic bodies, thus putting an obstacle reciprocally to their own movement—gas is the result; when the field of the movement of the atoms is restrained, but not wholly stopped, a *liquid* is the product, and when the attraction is sufficient to produce cohesion, to keep the molecules confined to their proper sphere, that state of matter is called *solid*. All that changes the movement of matter, or the molecules which compose it, is a form of force: Thus weight, attracting matter to the center of the globe, is a form of force; so is heat, for it determines in the molecules of matter violent vibrations, or augments the rapidity of their movements in a right line—that which produces the measure of heat, called—temperature. Light is also a form of force, being the product of the undulations of the molecules of matter, transmitted by the undulations of that *milieu* which fills all space—ether. No person has ever seen a molecule, and the mind's eye can form no idea of force. All that is mysterious and incomprehensible in nature is attributed to things not less mysterious and also as incomprehensible. This has ever been the case with such phenomena as life, heat, magnetism and electricity. For the Greeks, heat was an animal which bit, later it was accepted as a fluid, which permeated and inflamed bodies, till Rumford demonstrated it was merely a movement, and Joule a quantitative form of energy. Thales and Milet imagined the lodestone was endowed with a sort of immaterial spirit, and the Greeks concluded amber was possessed of vitality because it attracted morsels of straw. Boyle held that amber emitted a kind of glutinous fluid which carried off light objects by attracting them toward the excited body. Du Fay imagined the theory of two fluids, Franklin of one, and that Cavendish completed, but it was Faraday who discovered the molecular theory of electricity, and Grove ranked it with light and heat as being a force of the same nature and simply a mode of movement. Deprived of dimension, inertia and elasticity, electricity cannot be a form of matter; consequently it is a form of force like sound, light and heat. The analogy between the conductibility of the different metals for heat and electricity is such, that were the metals pure, their manner of conductibility would be the same. When an electric current passes through a metallic wire, it heats the metal, and to a degree proportionate to the intensity of the current, till the wire becomes incandescent. All electric discharge is but a violent molecular movement, and this view is corroborated by the fact, that in vacuum, the discharge cannot take place. M. Plouké has shown that fine wires, traversed by powerful currents, present regular ripples, some peculiar crackings, causing the metal to become peculiarly brittle; hence, the vibratory movement of the molecules. M. Siemens calculates that New York could be illuminated by the force of the water falling at Niagara, and that a plow could be worked—the writer has seen such on the estate of M. Menier, as well as cranes worked for unloading

barges—by the transmission of electricity along an ordinary wire, generated by a machine one-third of a mile distant from the implement. Science can determine the quality of steam necessary to produce an electric current of a certain intensity, to yield a certain quantity of light; to determine the volume of a cable necessary to transmit instantly to the other side of the world a fixed number of words, and even when a break occurs in a cable, the point of interruption can be calculated to within a few yards. All this energy, all this power, is clearly a form of force.

No precise ideas exist respecting ozone, it is only of late that the attempt has been made to distinguish it from oxygen; the truth is, the physical properties of ozone are, up to the present, hardly known and cannot be distinguished from those of oxygen. Messrs. Hautefeuille and Chapus have just prepared by low temperature and strong pressure, a mixture very rich in ozone, and peculiarly characterised by a blue or azure color. The same gentlemen are at present occupied examining the *role* of that coloring gas in the atmosphere and its influence in diverse radiations.

There is nothing positively known by Science respecting the cause of whooping-cough, its evolutions, or its remedy. Doctors at best can only prescribe palliatives. It is an affection grave, entailing a mortality of five to ten per cent. It was generally considered that the inhalation of the vapors in the atmosphere around gas works was an infallible remedy, but M. Roger has gone into the matter with the gas companies, who conclude, the children who do not return have been cured. The inhalation neither lessens the period of evolution of the disease, nor amends its nervous, febrile stages.

PROCEEDINGS OF SOCIETIES.

FINAL PAPERS READ AT THE NATIONAL ACADEMY OF SCIENCE MEETING.

The fall meeting of the National Academy of Sciences closed with five of the most brilliant papers on the list, and the Academy was declared adjourned by Prof. Marsh without a farewell address or other literary entertainment. Including the biographical notes by Prof. Cope, the Canids and Mimoravids of the Miocene formation of the West, and the memorandum of Prof. James Hall on the Relation of the Oneonta and Montrose sandstones to the sandstones of the Catskill Mountains, some twenty-seven papers have been read, many of them of permanent value, and some of them (such as Prof. Langley on the thermal balance, and that of Prof. Wolcott Gibbs on the application of electrolysis to the quantitative determination of metals in (solutions) constituting landmarks of prog-

ress in their respective fields. Prof. Henry Draper's photographs of the nebulæ of Orion must also be mentioned as contributions of the highest significance in physical astronomy, although not ranking, perhaps, with his brilliant discoveries from study of the solar spectrum. The objective lens with which this remarkable feat in photography was accomplished, was one of four which were manufactured according to a formula devised by Mr. Lewis M. Rutherford, of this city. It was originally manufactured to order for the Portuguese Government, and Mr. Rutherford was decorated a Knight of the Order of St. Ignacio in rcognition of his services. It differs from ordinary telescopic objectives in forming the image from the rays employed in photographing, not from those that are transmitted to the eye by a lens of the common pattern. Without this lens it would be impossible to obtain a photograph of the nebulæ of Orion. The several memoirs of Prof. Agassiz have dealt, in one way or another, with the results obtained by the last expedition of the steamer Blake, of the United States Coast and Geodetic Survey. As *Nature* for September 30 remarks, the work performed by the Coast Survey has received too little attention from the scientific classes in this country, and its brilliant results are but vaguely appreciated. An official report of the work done by the Blake under the superintendence of the Hon. Carlile P. Patterson, not, however, embracing its results in natural history, has recently gone through the government printing office at Washington. It was prepared by Lieutenant Commander Charles D. Sigsbee, of the Blake, to whose invention and fertility of resources the expedition owes a large part of its success. The work of the Bibb and Hassler, which preceded the Blake in this field, has been rendered familiar to naturalists through the memoirs of the late Count Pourtales; but the biological observations more recently obtained by the Blake have not yet been rendered fully accessible. They are in course of publication under the direction of Prof. Agassiz, but only a part of the series has yet appeared. The memoir of Prof. Marsh on the dimensions of the brain and spinal cord in extinct reptiles, as compared with living representatives of the same genera and species, and Prof. Ogden N. Rood's extraordinary paper on high vacua, must also be reckoned as contributions of which American scientists may well speak with pride. On the whole, the volume of transactions for 1880 will compare favorably with any preceding volume since the National Academy of Sciences was founded, and will be sought with avidity and treasured with solicitude by the ablest representatives of science in Europe as well as in the United States. There has been absolutely no padding in the papers read; few have exceeded twenty minutes in delivery; the majority have occupied not more than ten or fifteen minutes.

The first paper on the list was by Prof. Henry Draper, on "Photographing the Nebulæ of Orion," the text of which was as follows: "The gaseous nebulæ are bodies of interest, because they may be representing an early stage in the genesis of stellar or solar systems. Matter appears to exist in them in a simple form, as indicated by the simple spectrum of three or four lines. It is desirable, therefore, to ascertain what changes occur in the nebulæ, and to determine, if

possible, the laws regulating their internal movements. Drawings have been made of some of the nebulæ, and especially of the nebulæ in Orion, for upward of 200 years. But drawings are open to the objection that fancy or bias may distort the picture, and it is therefore difficult to depend upon the result and compare the drawing of one man with that of another. To apply photography to depicting the nebulæ is difficult, because these bodies are very faint, and, of course, owing to the earth's motion and other causes, they seem not to be at rest. They require a large telescope of special construction, and it must be driven by clock-work with the greatest precision. All such difficulties as those arising from refraction, flexure of the telescope tube, slips of loose bearings, atmospheric tremor, wind, irregularities of the clock-work, foggy or yellow state of the air, have to be encountered. The photographic exposure needed is nearly an hour, and a slip or movement of a very small fraction of an inch is easily seen in the photograph when it is subjected to a magnifier.

"The means I have used to obtain what is now presented to the Academy are as follows: First, a triple achromatic objective of eleven inches aperture mark according to the plan of Mr. Lewis M. Rutherford, for correcting the rays especially used in photographing. This telescope is mounted on an equatorial stand, and driven by clock-work that I have made myself. The photographic plates are bromo-gelatine, and are about eight times as sensitive as the collodion formerly employed. As to the picture itself, it will be observed in the copies before you that the nebula is very distinct in its bright position. The stars of the trapezium, and some others, are so greatly over-exposed that under the magnifying power employed, namely, 165 times, they assume a large size, partly from atmospheric tremor and partly from other causes. In the lower right hand corner of the picture is a photograph of the trapezium of only five minutes' exposure, and this shows the individual stars plainly. The nebulæ present a knotted structure, as if a process of aggregation was going on, but on this topic I will not make any statement until I have a larger collection of original negatives, so as to determine what effects different lengths of exposure will produce. I should add that it is more probable that much more of the nebulæ will be obtained in the pictures taken in the clear winter weather. This photograph was made at the end of September, when there was some fog and yellowness in the air, but, nevertheless, the original shows traces of the outlying streamers seen in the drawings of Lord Ross, Trewvalet, Band, Lassell and others. A series of photographs taken during various parts of the winter season, and in different years, will give the means of determining with some precision what changes, if any, are taking place in this body."

Copies of the photograph in the form of an artotype enlargement were presented, which will be preserved by the recipients as the first ever successfully executed. The negative was taken on September 30, the exposure being fifty-one minutes. The large stars of the constellation are somewhat indistinct from the over-exposure necessary to obtain an impression of the nebulæ. In the lower

right hand corner appears a small photograph of the trapezium alone, with only five minutes' exposure.

The second paper on the list was an extremely abstruse dissertation by Prof. George F. Barker, of the University of Pennsylvania, on "Condensers for Currents of High Potential." The reading occupied fifteen minutes, and was followed by the memoir of Prof. C. S. Peirce, of the United States Coast and Geodetic Survey, on the "Ellipticity of the Earth as deduced from Pendulum Experiments"—a work upon which the author has been for many years engaged, and in the course of which he he has arrived at some new conclusions. The experiments were undertaken at the instance of Superintendent Patterson, of the Coast Survey, and their results, as communicated to the scientific world from time to time, have been highly commended by European mathematicians. Prof. Peirce began by alluding to some of the difficulties connected with pendulum investigations, particularly those relating to the coefficients of the effect of temperature and that of atmospheric pressure. The latter was determined in 1829 by Sabine, and still later, Baily, in his review of Foster's experiments, undertook to correct all former results and to construct a coherent table. The first determination of the coefficient of the effect of temperature was that of Kater, which has long been an authority among men of science. When Prof. Peirce undertook his work, at the suggestion of Superintendent Patterson, he had before him the results of previous experimentalists. His observations have extended over a series of years, and have been conducted with appliances of extreme delicacy. Some of his conclusions are at variance with accepted doctrines. He finds, for example, that the correction hitherto made for the attraction of elevations is without actual foundation in fact. An island in the ocean, instead of making necessary a correction for its elevation above the general level, is without such influence as has previously been supposed on the vibration of the pendulum, and the same principle applies to elevations of other descriptions. In his memoir Prof. Peirce submits extensive tables of his results at different points. The paper was discussed by Prof. Peters and others.

Prof. Agassiz followed Prof. Peirce in a description of Sigsbee's gravitating trap for bringing up organisms from different sea depths and investigating the strata of marine life. Prof. Agassiz first described the instrument and compared it with the unsatisfactory big formerly use. It consists essentially of a cylinder furnished with a sieve and valve at the bottom, which is sunk to the required depth—100, 500 or 1,000 fathoms, as the case may be—filled with water. When at the proper point for taking a haul a heavy ring is liberated and slides down the cable until it comes in contact with a device for opening the valve. The latter opens and the water flows in, displacing the volume of water contained in the cylinder, and carrying with it marine organisms living in the stratum under investigation, which are arrested by the sieve and thus lifted to the surface. The result had then, Prof. Agassiz said, was to prove there was actually no difference between the organisms at the surface and those living at a depth of fifty fathoms.

In sections of the Atlantic, so abundant at the surface in tunicate that the sea seemed actually like a moving mass of life, genera and species were as numerous and varied at fifty fathoms as they were upon the immediate surface. The next fifty fathoms contained the same types, but the genera were less numerous. They counted seventeen genera of pelagic organism upon the immediate surface in one of those investigations, but only five of them were brought up when the trap was let down to a depth of 100 fathoms. Prof. Agassiz concluded with a high compliment to the ingenuity of Commander Sigsbee, whose invention had surmounted so many difficulties connected with the study of submarine biology. He believed that the bodies of pelagic organisms brought up from great depth were the carcasses of animals that had perished of age or accident upon the surface, and had slowly settled to the bottom to furnish food for its living hosts. It required from three to four days for a dead tunicate to sink to a depth of 1,000 fathoms.

With the paper of Prof. Marsh on the "Dimensions of the Brain and Spinal Cord in Some Extinct Reptiles," the work of the season was closed. Prof. Marsh reminded the members of the academy by way of introduction that some five years ago he had contributed a paper on the dimensions of the brain in extinct mammals, and had then established the proposition that the older the type the smaller was the dimensions of the brain. Among the mammals of the Tertiary period there had been a gradual increase in the capacity of the brain-box and in the volume of the contained nervous tissue. Moreover, this increase in volume had mainly concerned the cerebral or intellectual portion of the encephalon, so that it might be urged that there had been a gradual advance in intelligence associated with this advance in brain development. Since laying before the academy his memoir on the mammalian brain he made many more observations, and in April last last, as his hearers would remember, he had the honor of laying before the academy evidence of the fact that the same law of progressive increase in cerebral volume was followed by reptiles and fishes by comparing the brains of extinct with those of surviving genera and species. In general the brains of the earlier types were not more thon one-third as large as those of the corresponding types of the Tertiary period, and this was true of all the different groups he had examined, embracing the crocodiles, dinosaurs, as well as the higher forms. He should call attention at present to the small brain of a gigantic reptilian of the jurassic formation which he had recently examined. This immense animal, though thirty feet in length, possessed a brain scarcely as large as that of an ordinary dog, as judged from the capacity of the brain cavity. But the most remarkable feature of its nervous system was an immense enlargement of the spinal cord in the sacral region, where the bone was so excavated as to form an immense vaulted receptacle several larger than the brain cavity. The sacrum consisted of four vertebræ, which were well ossified and of great solidity, and within this was contained, during the life of the animal, a posterior brain—if he might use the term—which was eight times as large as the encephalon. The point was of very curious interest, not only as a fact of fossil anatomy, but in respect to the physio-

logical inferences that might be drawn from it, into which he did not propose to enter. It was so remarkable, indeed, that he took occasion to examine other examples of the same species before accepting it as a general fact of extensive application. Upon recurring to some younger specimens of the same gigantic saurian, he was enabled to verify the existence of the cavity in every instance, and to prove that sacral enlargement of the cord in extinct reptilians was an extraordinary fact. If it had appeared in a single instance in must, of course, have been regarded as a phenomenon due to injury or disease; but in all cases since his attention was attracted to the point by this enormous creature he had found the posterior cavity in extinct reptiles.

There was nothing analagous to this sacral enlargement, Prof. Marsh continued, in existing vertebrates. The aurphiax had absolutely no brain—that is no cerebral enlargement of the cord at the anterior extremity, but there was an enlargement of the spinal cavity at the sacrum which answered to what he had observed in extinct species. He would not take the time of his colleages by drawing any conclusion from the facts he had stated. Prof. Rood inquired if the sacral enlargement was in such a position as to furnish a point of origin for the nerves of the leg. Prof. Marsh replied that such was the case, and that the creature had very powerful hind legs. But the fore legs were equally strong, and there was no corresponding enlargement.

After concluding his paper, Prof. Marsh read the necrological roll for 1880. Three members had, he said, been removed by death, namely: J. Homer Lane, of Washington; Count Pourtales, whose name was so familiar from contributions to the literature of the Coast Survey; and Prof. S. S. Haldeman. He appointed Prof. J. E. Hilgard, Prof. Alexander Agassiz and Prof. J. J. Le Conte to prepare memorials of the deceased members. The meeting was then adjourned.

GEOGRAPHICAL.

THE HOWGATE EXPEDITION.

INSTRUCTIONS TO THE COMMANDER.

WASHINGTON, D. C., June 22, '80

LT. G. C. DOANE, U. S. A.—Sir: I take pleasure in assigning you to the command of the permanent party of the expeditionary force now on its way to Lady Franklin Bay, in the Arctic region, and I shall expect each member of said party to render full and prompt obedience to your directions.

The short time at my disposal since receiving notice of your intention to join the party, prevents me from entering into detail, and I shall, therefore, limit my-

self to a few general directions, leaving the details to be arranged in accordance with your own judgment, after reaching the location of the permanent station.

1st. If unable to reach the latitude of Lady Franklin Bay, and being forced to return to the United States during the year, you will *land* the *material for the house*, and also the *pemmican*, at the farthest northing made, taking such note of the location as will enable it to be readily found by any succeeding party.

2d. On reaching Lady Franklin Bay, your first care will be to examine the coal bed reported by the British Expedition, and ascertain if coal can be easily secured in sufficient quantities to supply your party with all necessary fuel. If satisfied of this, you will make a statement of the fact in writing, and having this paper signed by *all* the members of the party proposing to remain, will send it to me by the captain of the Gulnare. You will then leave the house, lumber, pemmican and other stores, for use of the party landed, together with sufficient provisions to last you until September 1st, 1881, provided such provision can be spared by the capain of the Gulnare. If he reports that all the provision will be needed for use of the ship, you will then simply land the other supplies, and return with the vessel to the United States, bringing, of course, your party with you.

I do not wish you to run any unnecessary risk, and prefer to have you return the present season, if you are not satisfied, on reaching the station, that you can remain there and prosecute the work with entire safety and as much comfort as can be reasonably expected in such a climate.

You will please read these instructions to the members of the party, in order that they may understand their relations to you. Wishing you success and a safe return, I am, Very truly yours,

H. W. HOWGATE.

NARRATIVE OF HENRY CLAY.

The following letter from Henry Clay, Esq., to friends in this city, has been kindly furnished us for publication. Mr. Clay will remain at Rittenbenk all winter.

On Board Steamship "Gulnare," Rittenbenk, Greenland, Aug. 22.—As I will remain here in Greenland this winter, I will now begin a letter to you, in order to have it ready to be sent by the "Gulnare," on her return to Washington. Owing to a series of adverse circumstances our expedition has been a failure, and as soon as a sufficient supply of coal can be obtained, the whole party, with the exception of Dr. Pavy and myself, will return to the United States.

When I last wrote to you, we were at St. Johns, N. F.

* * * * * * *

At last, on the 30th of July, about 4 o'clock, a. m., we weighed anchor and steamed out to sea. We had rain in the morning and a dense fog all day, which prevented our taking an observation. Our course was E. NE., and we made good time; about ten knots an hour.

The next day, the 31st, after running about 230 miles, we changed our course to the north. We had no fog, but it was so cloudy all day that we could not see

the sun, and hence could take no observation with the sextant. We calculated our position at noon, however, by "dead reckoning," and found it to be about 52° N., longitude 50° W.

August 1st was clear and beautiful. Our position at noon was lat. 53° 47′ N., lon. 46° 50′ W. At night we had rain and fog.

The next day was so cloudy that we could take no observation. It was the first Monday in August, election day in Kentucky, and I could not help thinking of what was transpiring in Louisville. I wondered who would be elected prosecuting attorney; if Gen. Duke would be re-elected; if Humphrey would be elected, and all the other candidates. I believe I am personally acquainted with them all. But I was soon roused from these meditations, for about 2 p. m., a terrific gale sprung up from the northeast. The sea ran very high, and the vessel rolled and pitched at a fearful rate. For the first time in my life, I felt a little sea sick, but I managed to hold my own, and was soon all right again. The storm continued all night, and the next morning increased in violence. Our captain and mate, both old whalers, said it was the severest gale they had ever encountered in that latitude. The waves seemed literally mountains in height and every few minutes broke over the deck with a noise like thunder, shaking the vessel from stem to stern. Half the time our deck was under water. The captain looked serious, but said nothing, except to give orders to the crew. One of our whaleboats was washed away, the bulwarks on our quarter-deck were stove in and we leaked badly. The water came into the cabin and flooded everything and everybody. A large part of the material for our house had been stored away on deck, which rendered the vessel somewhat top-heavy, and prevented her from righting herself when a wave dashed over her. All this had to be cast overboard, and as I saw it leave, plank by plank, I felt that the colony at Lady Franklin Bay was a dream of the past.

All this time the water came pouring in streams into the cabin. We knew that something was wrong, but not until we arrived at Godhaven did we ascertain the cause. We then found that a large plank, nine feet long by fourteen inches wide, had been torn from our starboard quarter, and several others loosened. This was above the water-line, but every wave that dashed against it poured a stream of water into the cabin. The gale continued with unabated strength until 2 o'clock on the morning of the 4th, when it died away as suddenly as it had come. When I went on deck at 7 o'clock the sea was perfectly smooth, with just enough swell to give a gentle motion to the ship. We seemed to glide almost instantaneously from a rough sea into smooth water. We had passed Cape Farewell, and I think the coast of Greenland protected us from the gale. This is the only way I can account for the sudden change.

Though we did not get a sight of the cape, we saw some of the icebergs which usually hang about it. They were so numerous that on the horizon they appeared like a continuous, impenetrable line of ice. Some of them were very large, and they assumed almost every conceivable shape. About 7 o'clock we

caught a glimpse of land, and at 12:30 we passed in sight of Cape Desolation, most appropriately named.

We steamed along all day, August 5, in sight of the coast of Greenland, which was not more than ten miles off. I will not say anything about "Greenland's icy mountains," the hackneyed phrase repeated by so many travelers, but most of the coast was mountainous, and nearly every mountain was crowned with ice and snow. Between the mountains were deep ravines, and the ravines were filled with glaciers extending inland as far as the eye could reach. The sea was smooth and the weather pleasant, so I spent most of the time on deck.

The days had been gradually growing longer as we proceeded north. This night (August 5) the sun set about 9 o'clock, but there was really no darkness—it was twilight all night. At 12 o'clock I was able to read the writing in my diary. We could follow the course of the sun after it set by a broad streak of brilliant red on the horizon, which increased in brilliancy and dimensions until the sun reappeared at 3 A. M. It was the most beautiful sight I ever saw. The weather was mild and pleasant and the sea as smooth as glass, I was on deck until very late, or, rather, early. Indeed, the deck was at that time decidedly more comfortable than my state-room, for my bed had been saturated with water during the storm.

An aurora tried to display itself, but made such a poor show in the bright twilight that it soon retired in shame.

The following day was clear and pleasant in the morning, but a fog settled down about 4 P. M., and the sea became quite rough. One of the sailors, Peter Du Prince, an old salt, attributed the bad weather to the fact that Stein, our engineer, had shot several gulls the day before. This is a very common superstition among sailors. Peter said he had noticed it ever since he was a boy, and found that bad weather invariably followed when birds were shot from the ship. This "ancient mariner," Peter, is a wonderful character, but I have no time to devote to him. He says he cannot tell exactly how old he is, as he lost his papers when he was shipwrecked off Cape Horn.

On Saturday, August 8, at 5:15 P. M., we dropped anchor in the harbor of Godhaven. It is a small harbor, about 600 yards long by 400 wide, with a very narrow entrance, which cannot be seen until you are almost on it. It is, however, very safe and secure, and we were glad to rest there after our stormy passage.

KIDLISET COAL MINE, DISCO ISLAND, August 30.—I have had no opportunity to write anything since the 23d, but will now have to finish my letter, as the vessel will leave to day or to-morrow.

When I left off, we had just anchored at Godhaven. I am sorry that I have not time to give any adequate description of it or its inhabitants. The population consists of the Inspector and Governor and their families, two or three other Danes and about 130 Esquimaux. The Inspector is the chief man. He has charge not only of Godhaven, but of the whole of North Greenland. He is an

educated and polished gentleman. He and his family were very kind and hospitable, as indeed were all the Danes we have met. We have received nothing but kindness from them since we have been in Greenland. The Inspector's wife is a refined and cultivated lady. She speaks English more fluently than her husband, and in conversing with us he had frequently to refer to her when at a loss for a word. Their house, the best one in the place, is well furnished, and they evidently live in a somewhat luxurious style. They invited Dr. Pavy and myself to visit them this winter, which we will certainly do if we have an opportunity. Though he has a very common name—Smith—the Inspector is somewhat aristocratic and exclusive. He and his family keep themselves aloof from the other inhabitants, and have no social relations even with the Governor. Dr. Pavy and I had to apply to him for permission to remain in Greenland. At first he was a little inclined to refuse us. He could not exactly understand why we wanted to remain. He had heard of my grandfather, and thought that our remaining might have some political significance. He thought, perhaps, that the United States had some designs on Greenland, and had sent me as a kind of spy. But when we assured him that we were merely two enthusiasts on the subject of the North pole, and that we desired to remain here this winter for the purpose of gaining arctic experiences, etc., he very promptly acceded to our request. He advised us to stop at Rittenbenk, where there are ample accommodations, and gave us a letter to the Governor of that place, directing him to receive us.

Every little settlement in Greenland has its Governor, who is, in reality, nothing more than a trader. Most of them are uneducated, but all we have seen are polite and hospitable.

The natives are mostly half-breeds, there being very few pure-blooded Esquimaux in any of the settlements we have visited. Those of Godhaven do a lively trade in seal-skin slippers and other articles. They trade for provisions, clothing etc. About the only things we had to trade with were stockings, and I believe we left a supply for several years. One of the Esquimaux, named Frederick, a consummate rascal, who can speak little English, was quite facetious on the subject of our stock in trade. He said he believed we had nothing but stockings on board, we ate stockings, the name of our ship was Stockinus, etc.

I send you some pressed flowers. They are not well pressed and do not look very pretty now, but they were beautiful when growing, and you can see from them that this is not altogether a landscape of desolation. While there are no trees, and nothing similar to them, other vegetation is quite luxuriant. The hillsides and the valleys—the country is nothing but a series of hills and valleys—are liberally covered with verdure, and I can now well understand why this land is called Greenland.

At Godhaven we had some fine sport shooting eider-ducks, which were quite numerous. By the way, I must not forget to tell you that we met Hans Christian, the Esquimau who was with Kane, and who stole a team of dogs and

deserted him at Etah. He is now quite old, and is generally considered a lazy, trifling kind of a fellow.

On August 17 we had a snow storm, the snow falling to the depth of seven or eight inches.

The repairs on our ship were completed August 20, and the next day we left at 9:30 A. M. for the coal mine. We arrived at Rittenbenk—my future home—at 5:15 P. M. the same day.

Rittenbenk is situated on a small island about fifty-five miles, in a direct line, east of Godhaven. It is about the same size as the latter, and, though further from the sea, is almost as important a place. The inhabitants are all Esquimaux except the Governor (an old bachelor), his secretary and another Dane. The Governor, unlike most Governors of North Greenland, is an educated gentleman, and is very kind and hospitable. He gave us a good house, with two rooms and a kitchen, and promised to do everything in his power to make us comfortable. He can speak English pretty well, and seems to look forward with a great deal of pleasure to our company this winter.

The following day, Sunday, we took breakfast with the Governor, and I tasted reindeer and ptarmigan, for the first time, both of which were delicious. At night the natives had a dance, and, though it was Sunday, I could not resist the temptation to see it. The music was furnished by two violins in the hands of two old Esquimaux. All the modern dances were indulged in, from a quadrille to a waltz. The native ladies danced and acted the same as our fashionable ladies do on similar occasions—if anything, they danced more gracefully, as they had no dresses and skirts to encumber their motions. The men, too, were more at ease, as they were not in perpetual fear of treading on their partners' skirts. Of course, as I do not dance, I remained an idle spectator, but most of our party indulged in the sport. Indeed, the native gentlemen were kept completely in the shade, and could find no partners until our party left.

On Monday, August 23, we landed stores for Dr. Pavy and myself—everything to make us comfortable—provisions, clothing, cooking utensils, etc., and, besides, a great many books and other reading matter.

After landing our stores we left Rittenbenk for the coal mine of Kidliset, about forty miles distant. We dropped anchor that night about 10:30 in a small exposed bay, three miles north of Sakkak. The bay was very shallow, and we came near running aground. Sakkak, a small settlement, is situated on the peninsula of Nomsoak, part of the main land of Greenland. It is separated from Disco Island by Waigat Strait, about sixteen miles wide.

On the morning of the 24th, the Governor of Sakkak came on board, from whom we obtained seven natives to assist in mining coal, and at 11:30 A. M. we started across the strait to the coal mine. The wind was blowing hard and the strait was quite rough, so as there is no harbor at the mine, we were forced to put back. But, instead of going to our anchorage of the night before, we put into the harbor of Sakkak, very shallow and scarcely wide enough for a ship to swing

with the tide. The Governor is the only Dane in Sakkak, and he is married to an Esquimaux. After supper I went hunting with our two engineers. After walking a long distance we succeeded in bagging nine ptarmigans, and returned to the vessel about half-past eleven o'clock. Think of shooting partridge at ten o'clock at night! We went hunting several times in this neighborhood with much better success. One day I killed fifteen and another day thirteen ptarmigans. They are similar to the pheasants or partridges we used to get in Montreal, and are delicious eating.

The next day, the 25th, we made another start for the coal mine, but the sea was still too rough for us to land, so we put back into the small bay where we had anchored Monday night. We waited there until Friday, the 27th, when, at 4 A. M., we again made the attempt to reach the mine, this time with success. The coal is found in the face of a bluff about sixty feet high, which rises abruptly from the beach. The vein of coal is about two feet thick, and extends for some distance along the face of the bluff, forty feet from the base. The coal is of an inferior quality, but burns well in our furnaces and stoves. It does not give us much heat as our bituminous coal, and burns out much quicker, but still it is much better than no coal at all.

As soon as we dropped anchor we landed a party of men and set them to mining. By supper-time we had landed on board about eighteen tons,—a pretty good day's work. We then weighed anchor and went back to our old harbor, leaving the miners, with tents and provisions, on shore. We were forced to do this on account of the insecurity of our anchorage at the mines. There was no bay or harbor of any kind, and it was exposed to the least wind that might spring up. Besides, the icebergs were a constant source of danger. The straits were full of them, and there were several large ones in our immediate vicinity. We had some narrow escapes from these, as they were borne toward us by the current or the tide. Several of them came in contact with us, and one of them carried away our anchor. Altogether, they were not agreeable companions, and we were not solicitous of forming an intimate acquaintance with them. But it seems that in avoiding them we were "jumping from the frying pan into the fire," for no sooner had we entered our harbor than we ran aground. Fortunately, however, the bottom was of mud instead of rock, and so no serious injury was done to the vessel, and at high tide we easily got afloat again.

On the 28th it snowed and rained all day, and was so cold and disagreeable that we remained at anchor. I pitied the poor fellows we had left on shore, but it seems they were very comfortable in their tents. Of course they were unable to do any mining.

Yesterday, Sunday, was mild and pleasant. We remained all day in our harbor, but the men on shore made up for the lost time on Saturday, and worked in the mine. They were excusable, I think, for it was a case of necessity. When we arrived here this morning we found about ten tons of coal already mined and sacked, ready to be taken on board. The men are now hard at work

mining and loading the vessel, and the Captain expects to get off to-night. Dr. Pavy and myself will be left, either at Sakkak or Rittenbenk, and the ship will start on her return voyage.

Yesterday we purchased two seals which had just been killed by the Esquimaux, and this morning I tasted my first seal meat. It is much better than I expected it would be, and I have no doubt I will soon acquire a fondness for it. They are very abundant in the winter and can be purchased for about fifteen cents apiece.

I will get one of our party to mail this in the States, and to send the flowers and slippers by express. I will get you all sorts of curiosities this winter and next spring, and will also gather more flowers and have Dr. Pavy press them for me.

You can write to me next spring. Direct to Rittenbenk, North Greenland, care of Inspector Smith, Godhaven, and send via Copenhagen, Denmark. A Danish vessel will start out about the 1st of April, which will carry the mails. If you can, send me some newspapers. The *Courier-Journal* for January 1st contains an abstract of events the previous year. If possible, please send me that.

I will keep an elaborate journal this winter, and send it to you next spring. I do not think Capt. Howgate will be disheartened by this failure, but will send out another expedition next year. By remaining here this winter I can learn the habits and customs of the natives, especially their manner of sledge-travel, and obtain other information which will be useful to me in the future. If no arctic expedition sets out next year, I will return to the United States in the fall, via Denmark.

I must now close, as I have a great deal of writing to do yet. I am secretary of the expedition, and have to get my papers in order and make a written report before I leave.—*Courier-Journal.*

THE CORWIN'S CRUISE IN THE ARCTIC REGIONS.

Capt. C. L. Hooper of the United States revenue steamer Corwin has just submitted to the Secretary of the Treasury a report of the cruise made by the Corwin in Behring Sea and the Arctic Ocean, in obedience to Department orders of May 15th last. The vessel made three trips into the Arctic regions, and its course covered the whole of the Arctic Ocean from Point Barrow on the American coast, to a point within twenty-five miles of Wrangel Land. Capt. Hooper was within three or four miles of Herald Island, and cruised on three sides of it. He was convinced that there was no human life on the island. He neither saw nor heard anything of the missing whalers. The following is a synopsis of the report:

The vessel sailed from San Francisco on May 22d, and arrived at Ounalaska on June 3d. As far north as information could be obtained it was learned, that the previous winter had been mild and pleasant. After giving in detail the move-

ments of the vessel and the trouble occasioned by the heavy ice, the report says that the Corwin got under way from St. Michael's on June 23d, with the hope of working north inside of the ice on the Asiatic side. A stop was made at Lawrence Island to investigate the reports of the deaths of natives by starvation. At the first village about fifty had died, at the second fifty-four dead bodies were counted, and it is estimated that one hundred and fifty died at this village. At the third village twelve dead bodies were found, and the deaths are estimated at thirty. At the fourth settlement there were found three hundred alive. It was ascertained that two hundred had died there. This general starvation occurred last winter. Capt. Hooper estimates that more than four hundred natives died of starvation on this island. The cause he attributes to the continued cold and stormy weather, with quantities of ice and snow which prevented the hunting of walrus and seal, as well as to the improvident habits of the natives, who are slaves to rum.

The vessel entered the Arctic Ocean on June 28th, and returned to St. Michael's on July 3d, for coal. On the 4th, the whaler Helen Mar was boarded, and from this vessel it was learned, that the missing whalers were forty miles southeast of Herald Island, in the clear water to the northward. The Corwin started north from St. Michael's on July 10th. On July 26th, the Corwin was in latitude 70° 50′ west, longtitude 175° 03′ west, only thirty-five miles from Herald Island, where a solid pack of ice was encountered, and no further progress could be made. Polar bears and two walrus were seen north of latitude 70°. The vessel returned to Cape Thompson to pick up Lieut. Burke. Returning north, Herald Island was sighted on August 4th, thirty-five miles distant. After working through the ice the distance was decreased to twenty miles. No signs of the missing whalers or of life were visible, and the weather becoming unfavorable, the vessel was obliged to turn southward again, arriving at Plover Bay on August 10th. On the 16th she returned to thirty miles east of Herald island, and on the 17th was within seven miles of the island, which bore south-southwest. On the 20th Herald Island bore northwest a distance of ten miles. The vessel made for it and got within three or four miles, when she was stopped by ice from twelve to forty feet high. A close examination was made of the island with a glass, while the Corwin lay so near, and Capt. Hooper says he was sure there were no human inhabitants on it. It is his opinion that the ice around Herald Island was old, that for two and three years it does not leave the island free, and that the ice rarely breaks up between the island and Wrangel Land.

On August 25th the Corwin reached Point Barrow, which is the most northern point of Alaska, and lacks only twenty-five miles of being the most northern point of the continent. "On the 11th of September," continues the report, "we saw the high hills of Wrangel Land, bearing W. ¼ E. (true). We ran in toward it until we came to the solid pack, the ice having the same general appearance as that we had previously encountered in the vicinity of Herald island, except in being covered with newly fallen snow, and being consequently white. We judged

the land to be about twenty-five miles away. The highest hills which seemed to be more distant, were covered with snow; others were partly covered, and still lower ones were almost entirely bare. The sight of this land repaid us to a certain extent for our disappointment in not finding Herald Island clear of ice, as we had hoped to do, in order that we might run lines of sounding and make a plan of the island.

That part of Wrangel Land which we saw, covered an arc of the horizon of about fifty degrees from N. W. ¼ N., to W. ¼ S., (true,) and was distant from twenty-five miles, on the former bearing, to thirty-five or forty miles on the latter. On the south were three mountains, probably 3,000 feet high, entirely covered with snow, the central one presenting a conical appearance, and the others showing rounded tops. To the northward of these mountains was a chain of rounded hills, those near the sea being lower and nearly free from snow, while the back hills, which probably reach an elevation of 2,000 feet, were quite white. To the north of the northern bearing given, the land ends entirely or becomes very low. The atmosphere was very clear, and we could easily have seen any land above the horizon within a distance of sixty or seventy miles, but none could be seen from the masthead.

There is a report that Sergeant Andrejew, a Cossack, reached this land in 1762 by crossing over from the main land on the ice with dog teams, and that he found it to be inhabited by a race of nomads called Krahayo. This report, however, is probably without foundation. Admiral Wrangel, who was the first to report the existence of this land, says: "They (the inhabitants of Nishne-Kolymsk,) knew a great deal about the three officers who were here in 1767, but could tell us very little about Sergeant Andrejew, who was here only five years before. They had learned generally that he had been to the Indigirka and afterward to the Bear islands, but were ignorant of his supposed discoveries, which were included in our most recent charts, and when we spoke of a land north of the Bear islands and traces of a nomad race in that direction, they treated it as a fable.' I mention this, not to prove that Wrangel Land is not inhabited, but to show, that if the Arctic exploring steamer Jeannette has been fortunate enough to reach that country, as we have reason to suppose and to hope, she is the first to do so, and her brave officers and crew should have the credit of it. Admiral Wrangel himself did not even see this land. He made his report of its existence from information obtained from the natives at Cape Joctan, that on very clear days the tops of high mountains could be seen to the northward. Capt. Kellett, Royal Navy, while cruising in the Arctic Ocean in 1845, claims to have seen Wrangel Land on August 16th. From his own statement, however, it appears that he merely caught an occasional glimpse of it through the clouds, which covered it in immense masses. Under such circumstances, as he himself admits, a mistake could easily be made. He describes the land seen by him, as being from twenty-five to sixty miles distant, and speaks of seeing distinctly the columns and pillars which characterize the higher headlands in the Arctic Ocean. If what he saw, was really

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land, the impossibility of distinguishing more than its general outline at such a distance must be apparent.

"I am of the opinion that Wrangel Land is a large island, possibly one of the chain that passes entirely through the polar regions to Greenland. That there is other land to the northward there can be no doubt. Capt. Keenan, then commanding the bark James Allen, reports having seen land to the northward of Harrison's Bay, a few degrees east of Point Barrow. Large numbers of geese and other aquatic birds pass Point Barrow, going north in the spring and return in August and September with their young. As it is well known that these birds breed only on land, this fact alone must be regarded as proof positive of the existence of land in the north. Another reason for supposing that there is either a continent or a chain of islands passing through the polar regions is the fact, that notwithstanding the vast amount of heat diffused by the warm current passing through Behrings Straits, the icy barrier is from six and a half to eight degrees further south on this side than on the Greenland side of the Arctic Ocean, where the temperature is much lower. As already stated, the nearest point of this land was fully twenty-five miles within the ice pack, and as the new ice had already begun to form, there appeared no possibility of reaching it. Even to remain in sight of it was to expose the vessel to great danger of becoming embayed in the ice, as the large quantity of drift ice which lay outside of us was likely to close in at any time, and remain in the pack all winter. We therefore worked out into clear water and headed to the eastward.

"Having visited every part of the Arctic that it was possible for a vessel to reach, penetrating the icy regions in all directions fifty to one hundred miles further than any vessel succeeded in doing last year, without being able to find the slightest trace or gain the least tidings of the missing whalers, we were forced to the conclusion that they had been crushed and carried north in the pack, and that their crews had perished. Had any of them survived the winter, it seems almost certain that they would have been found, either by the Corwin or by some of the whalers, all of whom were on the outlook for them during the summer. It was thought probable that the crew might have escaped over the ice and reached Herald Island, but a sight of the perpendicular sides of that most inhospitable-looking place soon banished even this small hope. As already stated, Herald Island is inaccessible to all but the birds of the air, and even were it possible for men poorly provided for such work as they were to reach the island, and to find shelter on it, starvation would be sure to follow.

Capt. Hooper reports that he learned nothing as to the whereabouts of the exploring steamer Jeannette. The report that she had been seen by the whalers entering a "pocket" in the northern pack to the northeast of Herald Island, which soon afterward closed and shut her in, was calculated to give the impression that she too had gone north in the pack. Capt. Hooper investigated this report and, it proved to be without foundation. Capt. Barnes of the whaling bark Sea Breeze reports having seen the Jeannette on Sept. 2, eighty miles south of Herald Is-

land. This was only five days subsequent to her arrival at Cape Leidze, from which point Capt. De Long wrote that he should attempt to reach Wrangel Land via Kollutchin Bay. "This being the case," says Capt. Hooper, "he would not be likely to go in an entirely different direction, and put his ship into the pack as early as Sept. 2. His most natural course would be to keep to the westward, and, taking advantage of every lead, work in and try to reach some point on the southern end of Wrangel Land, keeping his vessel out of the pack as long as possible, in order to profit by a favorable break in the ice, and gain even a few miles in the direction in which he wished to go. Failing to get sufficiently near Wrangel Land to find safe winter quarters, he might push on and endeavor to reach the New Siberian Islands, which, although some degrees further north, are often accessible, owing to more favorable location."

Capt. Hooper says that the Jeannette is a strong vessel, well fitted for encountering ice, and her crew were thoroughly equipped for traveling over the ice, if necessary, and he believes that. even though the vessel should be embayed in the ice and her crew compelled to abandon her, there would be no difficulty in reaching the mainland; or, if in the vicinity of Wrangel Land, in crossing over the ice with boats and reaching the whaling fleet. This, however, Capt. Hooper thinks would not likely be done until the completion of explorations, which he is convinced will have to be made in dog sleds, judging from what he has seen of the ice. He says:

"To attain a high latitude with a vessel in this part of the Arctic is impossible. The whalers follow the ice pack very closely between Herald Island and Point Barrow, and never have been able to reach the 74th degree of latitude as yet, while only one or two claim to have been as far north as 73 degrees. In the Greenland seas, on the contrary, it is no uncommon thing for whalers to reach the 78th degree or even higher. I believe that nowhere else within the Arctic Circle does the ice remain permanently so far south as between Wrangel Land and Point Barrow. I have no fears for the safety of the officers and crew of the Jeannette. The fact that they have not been heard from seems to indicate that the vessel is safe and that they consider themselves able to remain another year at least. Should they be compelled to abandon the vessel and cross over to the mainland during the winter, they would find no difficulty in reaching Plover or St. Lawrence Bay, where they would be well cared for by the Tchuktchis, as, in fact, would be the case at any place on the Asiatic or Alaskan coast."

EXTRACTS AND NOTES FROM AN OLD BOOK.

THREE YEARS' TRAVEL—1763-1776—THROUGH THE INTERIOR PARTS OF NORTH AMERICA FOR MORE THAN 5,000 MILES, BY CAPT. JONATHAN CARVER, GLASGOW, 1805.

The Ottawa Indians eat a kind of bread made of corn when in the milk; they slice the kernels from the cob and knead them into paste. For this no water is needed, as the milk in corn is sufficient. They then parcel it into cakes which are inclosed in basswood leaves, place them in hot embers, when they are soon baked; the flavor is excellent.

Green Bay was called by the French the Bay of Puants or "Stinking Bay." Carver remarks that the French had a different name for lakes or rivers, etc., from that used by the Indians, for, if in the presence of the Indians they were named, or a place named which they knew, they would be very jealous, for not understanding the conversation, they would become suspicious. From this, persons have since become perplexed with two or more names for the same place or object.

Carver mentions that sumach grew in plenty, the leaf of which, gathered at Michaelmas, when it turns red, is much esteemed by the natives. They mix about an equal quantity of it with their tobacco, which causes it to smoke pleasantly. He also speaks of a kind of willow (probably dogwood, or *cornus sericea*) termed by the French *bois rouge*, in English, red wood. Its bark, of one year's growth, is a fine scarlet, becoming gray is it grows older. The bark, scraped from the sticks, dried and powdered, is also mixed by the Indians with their tobacco, and held by them in the highest estimation for their winter smoking. The Indians also used leaves of another plant called by them Legockimac, to mix with their tobacco.

Carver concludes that the Winnebagoes originally resided in New Mexico, and being driven out took refuge in more northern parts about 1660. His reasons for believing this are: First. Their inalienable attachment to the Nandowessie Indians, who now (then) live 600 miles distant. The Nandowessie Indians, I suppose to be a branch of Dacotah or Sioux. Second. Their dialect differs totally from every Indian nation yet discovered—being uncouth guttural jargon, which none of their neighbors will attempt to learn. They converse with other nations in the Chippewa language, which is the prevailing language from the Mohawks of Canada to those who inhabit the borders of the Mississippi. Third. Their inveterate hatred of the Spaniard! and an elderly chief informed Carver that forty-six winters ago (forty-six years prior to 1763) he marched at the head of fifty warriors toward southwest for three moons; that during this expedition, in crossing a plain, they discovered a body of men on horseback who belonged to the black people—for so they called the Spaniards; further states that, fearing a defeat, they waited until night and rushed upon them and killed most of them, and they took

eighty horses loaded with what they termed white stone; this was probably silver and their horses were shod with it and bridles also ornamented with it. This affair probably took place on the head of Rio del Norte. The town of the Winnebagoes consisted of fifty houses, strongly built, with palisades, located on an island of nearly fifty acres. The Winnebagoes raised corn, beans, pumpkins, squashes and water melons, with some tobacco.

Carver next visited a town of the Sankies containing ninety houses, each large enough for several families. These were built of hewn planks, neatly jointed, and covered with bark so compactly as to keep out the most penetrating rain. Before the doors are sheds, where the people sit and smoke. The streets are regular and spacious. Their plantations are neatly laid out.

He next visited the Ottagammies, whom the French named Des Reynards or "the Foxes." About five miles from the junction of Wisconsin (spelled Ouisconsin) with the Mississippi, he observed remarkable ruins of a large town recently inhabited by the Indians. On the Mississippi, some miles below Lake Pepin, he perceived what seemed to have been an intrenchment or earth-work thrown up four feet high and nearly a mile in extent, and sufficiently capacious to cover 5,000 men. In form, circular, its flanks reaching the river. Though much defaced by time, every angle was distinguishable and appeared regular and fashioned with great military skill.

Near the River St. Croix there resided at that time three bands of Nandowessie Indians, called the river bands, for they chiefly dwelt near the Mississippi, and were then composed of eleven bands. Originally there were twelve, but the Assinipoils had some years previous revolted. Three bands reside near the river; the other eight were called Nandowessies of the plains, and dwelt to the westward. The names of the three river bands were Nehogatawonahs, Mawtawbauntowahs, and the Shahsiveentowas.

About thirty miles below the Falls of St. Anthony he notes a remarkable cave containing a transparent lake. He observed many rude hieroglyphics cut upon the inside of the walls.

The River St. Pierre (St. Peters) falls into the Mississippi ten miles below the Falls of St. Anthony, and was called by the natives Waddapawmencsotor.

At the Falls of St. Anthony a young prince of the Winnebagoes made an offering and address to the Great Spirit, and he considered the falls to be one of his residences. He first made an address to the Great Spirit, then threw his pipe into the stream; then the roll that contained his tobacco; next the bracelets of his arms and wrists; then a necklace of beads and wires from his neck; then his ear rings, during all of which he frequently smote his breast with great violence, threw his arms about, and appeared much agitated. He invoked that the Great Spirit would constantly afford Carver a bright sun, a blue sky, and clear and untroubled waters.

Carver passed up St. Pierre's river two hundred miles to the country of the Nandowessies of the plains. Among some of these he resided seven months. They

are termed the Wawpeentowahs, the Tintons, the Arahcootans, the Mawhaws, and the Schians. The other three are the Schianese, the Chongonsceton, and the Waddapawjestin, and they dwell higher up to the west of the River St. Pierre, on unbounded plains. The Nandowessies, united, consist of over 2000 warriors. Some of them drew plans of countries, with a piece of charcoal, upon the inside of the birch tree bank. He says, never did he travel in so cheerful and happy a company. Carver states that on a branch of St. Pierre's river, called Marble river, is a mountain from which the Indians get a sort of red stone, out of which they make the bowls of their pipes. A white clay also abounds, suitable for pottery, and a blue clay that the Indians use for paint. The latter they mix with the red stone and paint themselves of different colors.

The Chippeways, he speaks of as being the nastiest people he ever saw, and speaks of a custom, named by others, of searching each other's heads and eating the prey there found.

Carver particularly describes the lakes and streams west of Lake Superior. Lake Winnepeg he spells Winnepeek, and the Missouri river he speaks of as the Messorie. He relates that it is said that in the country of the Pawnees and Mandrakes are found a species of root resembling human beings of both sexes! He also states that a little to the northwest of the head of the Messorie (Missouri) and St. Pierre (St. Peters) the Indians told him that there was a nation smaller and whiter than the neighboring tribes, who cultivated the ground.

He speaks of the Shining Mountains far West, probably the Rocky Mountains, and the natives there have plenty of gold. Further on he speaks prophetically of these mountains, of which time has proved much, and says, "These mountains are more than 3000 miles long. Probably in future ages they may be found to contain more riches in their bowels than those of Industan, Malabar, or are produced from the golden coast of Guinea, nor will I except even the Peruvian mines. West of these mountains future generations may find an asylum, whether driven from their country by the ravages of lawless tyrants, or by religious persecutions, or reluctantly leaving to remedy the inconveniences arising from a superabundant increase of inhabitants."

Carver mentions a remarkable phenomenon connected with the straits of Michillimackinack. "In seven and a half years they rise three feet, and the next seven and a half years they decrease three feet." He had no opportunity to prove it, but something was taking place.

The book contains additional information concerning the origin, customs, etc., of the Indians of the Northwest; also botanical and geological information, all interesting.

G. C. B.

THE SYNTHETIC PHILOSOPHY.

ITS THEORY OF EVOLUTION.

One of the fundamental assumptions of Mr. Spencer's Synthetic Philosophy is that Nature, as man knows it, with its myriad forms, and these with their various faculties, is the product of a process of evolution. Evolution he defines as an integration of matter and a dissipation of motion. That is to say, the growth of any thing is the accumulation together, into a definite concentrated form, of matter, which previously existed in a more diffused and mobile state. This is applied to the celestial bodies as well as animal vegetable and inorganic forms on earth. This fairly represents the universal process of growth, but it fails utterly to account for either the matter that is integrated, or the force which is the cause of the motion dissipated. It fails likewise to account for the laws by which the matter in becoming thus integrated assumes certain definite forms, and repeats these forms generation after generation.

Evolution, however, is chiefly distinguished as such, by its explanations of the facts of Biological Science. Though Mr. Spencer has sought to elaborate it into an account of all things, it is by its account of the origin of species and the descent of man, through gradual differentiations and modifications of previously existing forms, that it gets its name; and by reason of the greater familiarity of readers with the writings of such evolutionists as Darwin and Haeckel, the word usually awakens in the mind this idea of the origin of vegetable and animal forms. It is here that the facts upon which it is founded are to be found; and it is in this department of scientific research, that the laws upon which it relies for support have been disclosed. Mr. Spencer, in discussing this branch of the subject, has grouped together a great mass of facts and laws, gathered from many different sources and verified by many observers and experimenters. These may therefore be fully accepted as ascertained truth; and a statement of the leading ones, quoted from Mr. Spencer's books, will show their real significance.

The theory being that all existing species are modifications of previously existing forms, running from man back to matter, it will be well to examine first how, and under what conditions such modifications can occur. In treating of adaptation of forms of organisms to their environment, Mr. Spencer says: "Since the function of any organ is dependent on the functions of the organs which supply it with materials and forces; and since the functions of these subsidiary organs are dependent on the functions of organs which supply them with materials and forces, it follows that before any great extra power of discharging its functions can be gained by a specially exercised organ, considerable extra power must be gained by a series of immediately subservient organs, and some extra power by a secondary series of remotely-subservient organs. Thus there are

required numerous and wide-spread modifications." Mr. Spencer illustrates this fact quite fully, showing that to establish any such modifications of a part involves a modification of the whole organism, which, at best, he concludes, is necessarily a slow process and one requiring great time for its accomplishment.

Concerning the limit to which such modifications may be extended, he says: "The general truth, that extra functions are followed by extra growth, must be supplemented by the equally general truth, that beyond a limit, usually soon reached, very little, if any, further modification can be produced. The experiences from which we draw the one induction, thrust the other upon us." After somewhat fully illustrating this truth he proceeds: "Thus the general fact appears to be, that while in each individual certain changes in the proportion of parts may be caused by the variation of functions, the congenital structure of each individual puts a limit to the modifiability of every part. Nor is this true in individuals only; it holds in a sense, of the species. Leaving open the question, whether in indefinite time, indefinite modifications may not be produced, experience proves that within assigned times, the changes wrought in races of organisms by changes of condition fall within narrow limits." In view of the great difficulty of affecting such modifications at all and in the long time required at best; and in view of the fact that they are limited to the congenital structure of the individual, and in view of the fact that the same holds true of species, it seems necessary to think that the type of the race cannot change, hence that there cannot be evolution; for if the modifiability of both species and individuals is limited within the congenital structure of the individual, it is impossible to conceive how that congenital structure, which is the type of the race, can become changed.

Yet, that there may be and are, variations within the limits of the type of any race of organisms, is a fact patent to common observation and recognized by science. Mr. Spencer thus refers to it: "It seems that in each species of organisms there is a margin for functional oscilations on all sides of a mean state, and a consequent margin for structural variations; that it is possible rapidly to push functional and structural changes toward the extreme of this margin in any direction, both in an individual and in a race; but that to push these changes farther in any direction and so alter the organism as to bring its mean state up to the extreme of the margin in that direction, is a comparatively slow process.

Change of type, then, could result only from so pushing an individual organism up to this limit, and pushing those of its offspring beyond. The facts of heredity will illustrate the feasibility of this. In treating of heredity, Mr. Spencer states these facts: "First in order of importance comes the fact that not only are there uniformly transmitted, from an organism to its offspring, those traits of structure which distinguish the class, order, genus and species, but also those which distinguish the variety. We have numerous cases among both plants and animals, where, by natural or artificial conditions, there have been produced divergent modifications of the same species, and abundant proof exists that the members of any sub-species, habitually transmit their distinctive peculiarities to

their descendants." Again, it seems necessary to think that if organisms habitually transmit the detailed peculiarities of their variety, as well as the greater peculiarities of their class, order, genus, and species; that there can be no modification of the type, no matter how many divergent modifications may be made, for if the typical peculiarities, as well as the minor details of the variety, are thus transmitted, it is perfectly manifest that, however many modifications may be transmitted, or however often, any change of type, under such circumstances, is wholly impossible. It is equally manifest that individual peculiarities, as well as peculiarities of the variety, cannot effect such modification, but it will be well to close the argument here, with a statement of facts from Mr. Spencer, he says: "While, however, the general truth that organisms of a given type, uniformly descend from organisms of the same type, is so well established by infinite illustrations, as to have assumed the character of an axiom, it is not universally admitted that non-typical peculiarities are inherited." Mr. Spencer, as will be seen in the quotations already made, believes that such non-typical peculiarities are transmitted, but here he shows that, while there is no dispute among biologists about the transmission of typical peculiarities, such transmission of non-typical peculiarities, by which alone evolution could be effected, is disputed. Therefore, it seems perfectly safe to think that in the face of such dispute, in the absence of universally admitted facts, showing that such peculiarities are transmitted, and with the transmission of typical peculiarities so infinitely illustrated that the fact of its occurrence has assumed the character of an axiom, there is no warrant for asserting any change of type resulting from heredity, while, as already shown, established facts show it to be impossible.

But if in view of such considerations, it were possible to conceive of such modifications being effected in the inheritance of individual variations, the question of the permanence of such changes would become an interesting one, and it may be well to examine the facts of biological science on this branch of the subject; and Mr. Spencer's Biology furnishes all that are needed. He says: "Pursuing the argument further, we reach an explanation of the third general truth, namely: that organisms and species of organisms, which, under new conditions, have undergone adaptive modifications, soon return to something like their original structures, when restored to their original conditions. Seeing, as we have, how excess of action and excess of nutrition in any part of an organism, must affect action and nutrition in subservient parts, and these again in other parts, until the reaction has divided and sub-divided itself throughout the organism, affecting in decreasing degrees the more and more minute parts, more and more remotely implicated, we see that the consequent changes in the great mass of the organism must be extremely slow. Hence, if the need for the adaptive modification ceases, before the great mass of the organism has been much altered in its structure by these ramified but minute reactions, we shall have a condition in the specially modified part that is not in equilibrium with the rest. All the remotely affected organs, as yet but little

changed, will, in the absence of the perturbing cause, resume very nearly their previous actions. The parts that depend on them will consequently, by and by, do the same, until, at length, by the reversal of the adaptive process, the organ at first affected will be brought back almost to its original state. This is a somewhat elaborate explanation of the process by which a commonly observed fact is brought about. It is not a new idea to people who have had experience with either vegetable or animal life that any changes wrought in either, by culture or breeding, are speedily lost if the artificial conditions be withdrawn. It is equally true in whatever direction the modifications have been wrought, for they will soon rise from a lower state to a higher, as well as fall from a higher to a lower when natural conditions are restored. How difficult it is to effect, and what sedulous care it requires to maintain such changes, is well known both in vegetables and animals. If, then, it is so difficult, and involves so many resisted changes to effect such modifications; if they are possible only within such narrow limits, never affecting the type; if they are of such doubtful transmission to posterity, while typical peculiarities are certainly transmitted, and if they are so difficult to maintain in the individual and so easily lost, it is difficult to see how species can have arisen in the way alleged.

These facts might be held to dissipate the evolution theory in this part of nature, but there are further well established facts of science that have an important bearing upon this subject. The origin and form and composition of the germs of which all forms of life, vegetable and animal, are developed into embryos and subsequently into adult organisms, is pretty well known; and Mr. Spencer presents a fair statement of the facts so far as he uses them. He says: "The germ out of which a human being is evolved, differs in no visible respect from the germ out of which every animal and plant is evolved." Mr. Spencer follows this with a statement of the process of germ development, showing that germs, indistinguishable in character if not indentically the same, in developing, travel a little way together and separate by degrees into the myriad forms of vegetable and animal life. These germs, in their ultimate state as germs, are but nucleated cells of protoplasmic matter, a description of which is given by Mr. Spencer in an appendix to his first volume of biology. He says: "In the early world, as in the modern laboratory, inferior types of organic substances, by their natural action, under fit conditions, evolved the superior types of organic substances, ending in organizable protoplasm; and it can hardly be doubted that the shaping of organizable protoplasm, which is a substance modifiable in multitudinous ways with extreme facility, went on after the same manner. As I learned from one of our first chemists, Prof. Frankland, protein is capable of existing under probably at least a thousand different isomeric forms; and, as we shall presently see, is capable of forming, with itself and other elements, yet more intricate, compositions that are practically infinite in their varieties. Exposed to those innumerable modifications of conditions which the earth's surface afforded, here in the amount of light, there in amount of heat, and elsewhere in the mineral quality of its aqueous medium, this extreme-

ly changeable substance must have undergone, now one, now another, of its countless metamorphoses."

This is a brief, but adequate statement of most important scientific facts. It brings to view the character of protoplasmic matter, from which the primordial cells from which all living organisms, vegetable and animal, spring; and of which they are chiefly composed. It shows us that it can be, and now is, produced in laboratory, which warrants Mr. Spencer's induction, that during the period in which things were being formed, the conditions of the laboratory were more than fully realized in nature, for the laboratory has not yet demonstrably developed protoplasm into an organism, while nature has. It shows the exceeding modifiability of this matter and its susceptibility of being developed into all most infinite forms of organisms and it warrants the conclusion that it was formed in the great laboratory of nature, over a long period of time, and under many various conditions, and hence would most likely be developed into many varieties of organisms, instead of one primordial form from which all others were subsequently evolved. It gives also the history of all living forms, from organic matter up to the germs, and the history of the germs, through the embryonic stages has just been noticed.

Here arises the question, by what agency has inorganic matter been thus developed into organic matter, then into protoplasm, then into germs, then into embryos, and then into adult individuals? Mr. Spencer attributes this work to force, which as expressed in motion he says follows the line of least resistance. Here recall the facts already quoted concerning the great difficulty of effecting changes in developed organisms, and the extreme modifiability of protoplasmic matter, and the question as to which appears the line of least resistance can be answered only in one way, which is unfavorable to the evolution theory. The unfailing transmission of the typical peculiarities, it has already been shown, makes the origin of species, in the way alleged, inconceivable; and it is seen that the character of protoplasm and the law of force show quite a different origin from that alleged. The creation theory as it is presented in the Bible, contemplates that all species had a common origin in the great laboratory of nature. Science, as formulated by the evolutionists, shows that this common origin was in protoplasm. It shows also that the origin of the individual is, and always have been, in this element, the laboratory of nature being confined, subsequent to the formation of organisms, to the bodies of the organisms. Evolution breaks this order of nature in assuming one origin for the individual and a different one for the species.

The next question that presents itself for consideration is, why do protoplasmic cells, indistinguishable from each other, develop into such varied forms, and always in the same form as the parent organisms? Mr. Spencer offers an explanation of this phenomenon, but it is too long for quotation. It is to the effect that protoplasmic matter is composed of molecules, each of which is constructed of many atoms; and that the complexity of the molecules arising from such formation is attended with a like complexity of polarity, which gives to the cell germs a tendency thus to develop in a certain way. This, it must be observed, is a theory based upon several other theories. In the first place, the atomic constitu-

tion of matter is a theory; and the polarity of such atoms is also a theory; both of which appear to be true, but neither of which has been demonstrated by experiment. To these Mr. Spencer adds the additional theory that these atoms are unlike, and that their polarity is unlike; for in no other way could their combination produce a complex molecule, or their polarity thus combined constitute a complex polarity. This assumed unlikeness of atoms, and of polarity of atoms, is unaccounted for. It is not embraced in his definition of evolution—and integration of matter and a dissipation of motion—for it is an integration of something else than matter—an integration of polarity. These complex molecules he calls "Physiological Units." From what has already been said of them, it would seem that they rest upon a very doubtful basis; but if this weakness be overlooked, and their existence and adequacy be conceded, it will be found that other and greater difficulties are encountered. If it be conceded that there are such units, and that to their existence is due the tendency of matter to grow into certain defined forms, the mystery is removed one step further back, and there occurs the question, why does organic matter form itself into such complex units? If this be accounted for by the same principle, which it seems must be done, because all the laws of evolution are general and, with appropriate modification, apply alike to all parts of the process, the mystery is again removed, and the question occurs: why does inorganic matter have a tendency to form itself into organic matter? This question cannot be answered by the same principle, for there is no form of matter behind the inorganic form. These physiological units, therefore, appear to lead to an unanswerable question, and explain the fact in explanation of which it is offered, only by a removal of the mystery supposed to be explained.

If, then, the only theory advanced by Mr. Spencer to explain this phenomenon, which lies at the foundation of all animal and vegetable forms, fails to explain it, it is safe to assume that an explanation must be sought elsewhere. In a recent paper on the "Unity of Nature," it is referred to the Duke of Argyll, whose book on "The Reign of Law" sufficiently establishes his standing as a scientist and thinker. He says: "There are structures in nature which can be seen in the process of construction. There are conditions of matter in which its particles can be seen rushing, under the impulse of invisible forces, to take their appointed places in the form which is to them a law. Such are the facts visible in the process of crystallization. In these we see the particles of matter passing from one 'molecular condition' into another; and it is impossible that this passage can be ascribed either to the old arrangement, which is broken up, or the new arrangement which is formed in its stead. Both structures have been built up out of elementary materials by some constructive Agency which is the master and not the servant—the cause and not the consequence of the movements which are effected, and of the arrangement which is the result. And if this be true of crystalline forms in the mineral kingdom, much more is it true of organic forms in the animal kingdom."

In some form and under some name all creeds and philosophies have recog-

nized this Agency in nature. It lies below the forms and laws of nature. As such every science recognizes it and knows it by its methods of working, which constitutes the laws of science. That it is a unity there is no longer a doubt, for it is found all sciences harmonize with each other, and classifications in nature are not sharply definite but arbitrary distinctions made for the convenience of knowledge. Of its limitation in space, if it have any, man can gain no information; for it shapes not only all earthly forms, inorganic and organic, but it shaped the earth itself, and the stars, and systems of stars, and binds them together in unity and harmony of movement. A place in nature where it is not is inconceivable; it is the author of all phenomena. Wherever phenomena occur, there it is present and at work. It penetrates and permeates all things. It has been observed of the ether, that it is so subtile that it might float through the most solid substances with the ease with which air floats through a grove of trees; but this Agency is so much more subtle that it penetrates the ether and gives it its vibratory power. It is the same that the atheist has called the "potentiality of matter," and that Mr. Spencer calls unknowable force.

Since it is such Agency that breaks up and forms combinations of matter, what must reason conceive to be its character? The structures it forms are of definite construction and adapted to the performance of definite functions, which thrusts upon us the induction of design and purpose. Design and purpose, and the form of the structure through which they are expressed anterior to its formation, can be only conceptions in a thinking mind. Their enforcement through a material structure can be conceived only as an expression of will. And it is manifest that forms cannot be thus constructed in a definite way and for a definite purpose by a constructive Agency that is not conscious of the purpose and design and the structure, which implies that this Agency is possessed of what man has called feeling. These qualities constitute personality, which shows that this agency in nature, apprehended by science, is the same as had been previously apprehended by religion and worshiped under the name of God. However it may be defined, and by whatever name it may known, the mind necessarily ascribes to it the same qualities, the same characteristics and the same functions in nature. It rules and guides the universe, and is the power that gives it action. It is not in physics alone that it is apparent, but its hand is perceptible also in the world of morals and of mind. Ever present everywhere, the movement of an atom or a world, the slightest shade of thought and feeling or the most momentous events are alike matter of its knowledge. There is no abyss of darkness and mystery between it and man. Little as man knows of its infinite ways, it is nevertheless as much a present reality as himself. It is his constant companion in his joys and sorrows, in his trials and triumphs, and in his beneficiencies and his crimes; and, doubtless, conscious of many of his motives of which he takes no cognizance himself. It requires of him obedience to the laws of his own being as the condition of his highest happiness, and has affixed to disobedience the penalty of pain.

ASTRONOMY.

A NEW CHRONOGRAPH.

BY THE EDITOR.

Mr. W. W. Alexander, of this city, has in use a chronograph, of his own design and construction, by the use of which he is enabled to determine the time of a star's passage across the meridian, or, more exactly, across the five vertical wires of his transit, and to note the time the star is bisected by the wire, to the tenth or the hundreth part of a second by merely pressing a spring.

The principle is as follows: A round disk of paper, placed upon a horizontal block of wood four inches in diameter, is made by accurately running clock-work to turn around once in a minute of sidereal time, or nearly so, (a slight variation may be corrected). A needle point is arranged at a short distance above the moving disk, which simultaneously with the pressing of the spring, makes a hole in the paper and readjusts itself in position in less than the hundredth part of a second. At each round of the disk, the needle point moves in toward the center of the paper the sixteenth part of an inch, which prevents confusion in distinguishing the punches. To illustrate its use, take the following example:

Suppose an occultation of a star by the moon, or an eclipse (the time of which is desired to be known) takes place at about 8 h. and 5 m. Then at five or ten minutes before that time, arrange and place the disk of paper in position and start the Chronograph running; then observe by a standard clock or chronometer the end or beginning of some exact minute; then touch the spring, which marks the paper; then go to where the observation is to be made, and simultaneously with the occurrence again press the spring, and another mark is left on the paper disk. Then remove the disk and place it on the reading dial, which will show, by the relative positions of the marks, the interval from the time of the first mark made to the one made at the time to be noted, to the tenth or one hundredth of a second. In this case suppose it showed 4 m. 12.7 s.; add this to the time of the first mark, 8 h. 1 m., which gives 8 h. 5 m. 12.7 s., the time by clock or chronometer at which the occurrence took place. Then by knowing the error of the clock or chronometer, from previous observations with the chronograph and transit, the observation may be made exactly correct, in time, by adding or subtracting this difference (*i. e.* aside from personal equation).

Another feature in its favor is this, that the marks on the disk are permanent, and can be preserved and read at leisure, thus obviating the necessity of using bright lights for night work and careful scrutiny of delicate lines and points at the instant of observation.

Mr. Alexander is a close and careful observer, and invented this instrument merely for his own use and convenience, but on account of its simplicity, durability and accuracy, it will doubtless be found so highly useful as to be speedily adopted by other astronomers.

XUM

THE SUN AND PLANETS FOR JANUARY, 1881.

BY W. W. ALEXANDER, OF KANSAS CITY.

The Sun on the 1st culminates or passes the meridian at 00 h. 4 m. 6.82 s., at an elevation of 27° 57′, and on the 31st at 00 h. 13 m, 47.31 s., at an elevation of 33° 42′.

The sidereal time of mean noon on the 1st is 18 h. 46 m. 07.97 s., and on the 31st 20 h. 44 m. 24.69 s.

Mercury on the 1st will culminate at 11 h. 2 m., a. m., at an elevation of 27° 07′, and on the 31st at 00 h. 33 m. p. m., at an elevation of 32° 56′. On the 26th it is in superior conjunction with the Sun.

Venus on the 1st will culminate at 2 h. 57 m. p. m., at an elevation of 35° 23′, and on the 31st at 3 h. 07 m. p. m., at an elevation of 49° 56′. Its apparent diameter on the 1st is 16″, and on the 31st 20″. It is fast increasing in apparent size and brilliancy.

Mars on the 1st will culminate 10 h. 33 m. a. m. at an elevation 27° 26′, and on the 31st at 10 h. 12 m. a. m., at an elevation of 27° 25′. It is quite small and hard to see, but is slowly enlarging.

Jupiter on the 1st will culminate at 5 h. 55 m. p. m., at an elevation of 54° 05′, and on the 31st at 4 h. 12 m. p. m., at an elevation of 55° 46′. It is slowly decreasing in size and splendor.

Saturn on the 1st will culminate at 6 h. 38 m. p. m., at an elevation of 57° 13′, and on the 31st at 4 h. 45 m. p. m., at an elevation of 57° 48′. Its rings are again slowly opening out to view, but its size and brilliancy is decreasing.

Uranus on the 1st will culminate at 4 h 16 m. a. m., at an elevation of 58° 04′, and on the 31st at 2 h. 15 m a. m., at an elevation of 58° 22′.

Neptune on the 1st will culminate at 7 h. 51m p. m., at an elevation of 64° 32′, and on the 31st at 5 h. 53 m. p. m., at an elevation of 64° 33′.

The Moon on the 1st culminates at 1 h. 16 m. p. m., and on the 31st at 1 h. 44 m. p. m. On the 3d it is a little south of Venus, and on the 6th and 7th it is a little north of Jupiter and Saturn, and on the 27th it is very close to Mars.

BOOK NOTICES.

REPORT OF THE COMMISSIONER OF EDUCATION FOR THE YEAR 1878: Hon. John Eaton, Commissioner. Government Printing Office: 1880; pp. 730, octavo.

We have heretofore referred to the work accomplished by General Eaton as most valuable and useful in matter as well as creditable in form, both to the Government and to himself, and we can only at present repeat this conviction, though an abstract of the volume before us would be far more satisfactory, had we the space for it.

The sources of information from which the matter of the Report is derived are Reports from States, Territories, and cities, from schools of all classes, and from all other institutions of an educational character, as libraries and museums. This material has increased more than eight-fold since 1870. To this must be added the foreign material, reports and periodicals which are examined and the most important information they contain summarized by the translator.

The Report is full and comprehensive, including information on almost every point connected with the education, not only of the children of each State, but of its teachers, its deaf and dumb, and blind, its medical, theological and law students; also its libraries, educational benefactions, its colleges and universities, schools of science, and the educational publications and patents. Following this is an account of education in foreign countries, and finally of the representation of education in the United States in the Paris Exposition of 1878, where 121 premiums were taken as awards in various classes, besides a gold palm to Gen. Eaton, the cross of the Legion of Honor to Dr. John D. Philbrick, the superintendent, and three silver palms to Messrs. Harris, Kiddle and Wilson, being nearly one-sixth of the whole number of awards made in this department of the Exposition. This shows how highly the world regards the school system of the United States.

THE RHYME OF THE BORDER WAR: By Thomas Brower Peacock. New York: G. W. Carleton & Co, 1880, pp. 162, 12 mo, $1.00.

This is a handsomely printed volume, by a gentleman of Topeka who has already acquired a fair reputation as a writer of poetry. This reputation will be in no wise lessened by his latest effort, which contains many genuinely poetic fancies and lofty passages. The introductory lines are especially good, and many of the descriptions of scenery and character are finely conceived and delicately portrayed. Among these we can only take time to mention the Poet and Song which abounds in such gems.

The poem will doubtless meet with a better reception in localities more remote from the scenes of the events described than in their vicinity, since it will be almost impossible to arouse any enthusiasm in the minds of those who participated in them or of those who knew the outlaws that are made prominent in this book, on either side, regarding their characters or deeds. Civil war is not the most exalted theme for the poet, at best, and the warfare of this Border lacked nearly all the elements of true poetry. Still, we must give Mr. Peacock credit for having made the most of his material and for having much of the imagination and descriptive power that belong to the poet. Experience and cultivation of his naturally fine qualifications will correct the defects in versification common to all young writers, and we may expect to see him, in riper years, attain an enviable position among western authors.

XUM

ON THE ORIGIN OF SPECIES: By Thomas H. Huxley, F. R. S., F. L. S., pp. 26, Quarto. J. Fitzgerald & Co., New York, 1880, 15c.

This re-print of the six lectures of Prof. Huxley, on the causes of the phenomena of organic nature, makes up Number Sixteen of the well-known and popular Humboldt Library. No more interesting lectures were ever delivered, and whether one agrees with the author in all of his conclusions or not, he cannot help being attracted and instructed by the graceful style and multitude of facts presented.

To those who want such works in a cheap form, the Humboldt Library offers a tempting prize.

OTHER PUBLICATIONS RECEIVED.

Annual Report and Statistics of the Meteorology and Mortality of the City of Oakland, California, by J. B. Trembly, M. D.; Longevity, No. 15 Humboldt Library series, J. Fitzgerald & Co., New York; Abridgement of the Nautical Almanac for 1881, Riggs & Bro., Phila.; Maritime Meteorology, by Thompson B. Maury, Phila.; Quarterly Botanical Index, L. B. Case, Richmond, Ind.; Anthony Republican, A. S. Lyndsay, Anthony, Ks.; Weekly Herald, Dr. Stephen Bowers, Clinton, Wis.

The *Literary News*, published by F. Leypoldt, New York, will be found a most useful periodical to all persons desirous of keeping up with the literary progress of the day, or who require assistance in building up either private or public libraries.

METEOROLOGY.

METEOROLOGICAL OBSERVATIONS AT WASHBURN COLLEGE TOPEKA, KANSAS.

PROF. J. T. LOVEWELL.

From November 20 to December 20, 1880, the period embraced in this report, has been characterized by a continuance of the cold, dry weather which prevailed in the first twenty days of November. By reference to the tables below, it will be seen, that during the last ten days the temperature has averaged more than ten degrees higher than in the two decades previous. The relative humidity has also been greater and the barometric pressure lesss The temperature has fallen below zero but once—December 6th, when it was −03°. This followed the night after a violent gale of wind which blew from the NW. for five hours, with a velocity of nearly fifty miles per hour. The same storm brought snow in many other places

further east and north. Snow has fallen here on three days: November 24th and 25th and December 16th. Not more than one inch remained on the ground at one time. The highest temperature reached was 61°, on December 13th. The greatest pressure was, reduced to sea-level and 32° F., 30.68 inches, Nov. 21st; the lowest was 29.32 inches, December 4th, preceding the gale mentioned above.

The rain-fall has been very light but the air has been moist, especially during the last ten days, preventing excessive evaporation. Ice has formed abundantly on the river and a large supply is being gathered for the ice houses.

The miles traveled by the wind has been more than one thousand less than the previous month, and on the day before the gale, December 4th, the total number of miles traveled was but seventy-four, the smallest distance in one day recorded by the anemometer since it was set up last May.

RECORDS DEDUCED FROM AVERAGES OF DAILY OBSERVATIONS.

	Nov. 20th to 30th.	Dec. 1st to 10th.	Dec. 11th to 20th.	From Nov. 20 to Dec. 20.
TEMPERATURE.				
Min.	12.9	12.3	26.7	17.3
Max.	26.6	33.4	44.0	34.7
Mean.	19.7	21.8	35.1	25.5
Range.	13.6	22.2	17.6	17.8
7 a. m.	13.2	12.8	28.6	18.2
2 p. m.	24.5	31.2	39.6	31.8
9 p. m.	18.4	19.9	31.7	23 3
Mean	19.8	22.4	32.8	25.0
REL. HUMIDITY.				
7 a. m.	.52	.70	.77	.66
2 p. m.	.59	.77	.67	.68
9 p. m.	.54	.70	.69	64
Mean	.55	.71	.72	.66
PRESSURE, sea-level, 32° F.				
7 a. m.	30.40	30.25	29.28	29.98
2 p. m.	30.32	30.16	29 92	30.13
9 p. m.	30.30	30 18	29.86	30 11
Mean	30.37	30.20	29.97	30.15
WIND.				
Miles Traveled	2,533	2,937	3,611	9,081
RAINFALL.				
Inches	0 25	.....	0.05	0.30

SCIENTIFIC MISCELLANY.

GENERAL WILLIAM B. HAZEN.

General Hazen, the newly appointed successor to the late General Myer as Chief Signal Officer of the army, was born in Vermont, appointed a cadet at West Point from Ohio, and is now a little more than fifty years of age. His original entry into the army was in 1855, as Brevet Second Lieutenant of the 4th Infantry. He was made Captain in the 8th Infantry in May, 1861. At the commencement of the War of the Rebellion he was on duty at West Point as an instructor in Infantry Tactics, which position he gave up to accept the Colonelcy

of the 41st Ohio Volunteers in November, 1861. His distinguished services caused his rapid promotion, being placed in charge of a brigade early in January, 1862, and appointed Brigadier General of Volunteers in November, 1862. He was highly complimented for his ability and gallantry at Murfreesboro by General Rosecrans, and afterward, for similar services at Chicamauga and Chattanooga, by General Thomas. In April, 1865, he was commissioned Major General of Volunteers "for long and continued service of the highest character and for special acts of gallantry and service at Fort McAllister."

Since the war he has continued to serve his country as Colonel in the regular army, and has written several works as the results of his observations at home and abroad. After his return from Prussia, where he accompanied the army in the campaign against France and was present with it during its investment of Paris, he wrote "The School and the Army in Germany and France," in which he gave the credit of the superiority of the German soldiers to their thorough training in the public schools of their country. Later he published a report on the "Barren Lands of the Interior of the United States," besides numerous magazine articles at different times. His confirmation was made by the unanimous vote of the senate, and it is the universal verdict of the press, so far as we have seen, that the appointment was one of the best that could have been made from the regular army.

A writer in a London paper, in discussing the photophone, says: The problem which Prof. Bell has attacked is that of the transmission of speech, not by wires, electricity or any mechanical medium, but by the agency of light. The instrument which embodies the solution of this problem he has named the photophone. It bears the same relation to the telephone as the heliograph bears to the telegraph. You speak to a transmitting instrument which flashes the vibrations along a beam of light to a distant station, where a receiving instrument reconverts the light into audible speech. As in the case of that exquisite instrument, the telephone, so in the case of the photophone, the means to accomplish this end are of the most ridiculous simplicity. The transmitter consists of a plain silvered mirror of thin glass or mica. Against the back of this flexible mirror the speaker's voice is directed. A powerful beam of light is caught from the sun and directed upon the mirror so as to be reflected straight to the distant station. This beam of light is caused by the speaker's voice to be thrown into corresponding vibrations. At the distant station the beam is received by another mirror and concentrated upon a simple disk of hard rubber, fixed as a diaphragm across the end of a hearing tube. The intermittent rays throw the disk into vibration in a way not yet explained, yet with sufficient power to produce an audible result, thus reproducing the very tones of the speaker. Other receivers may be used, in which the variation in electrical resistance of selenium under varying illumination is the essential principle. Other substances beside hard rubber—gold, selenium, silver, iron, paper, and notably antimony—are similarly sensitive to light.

XUM

POPULATION OF THE GLOBE.

According to "*Die Bevolkerung der Erde*," published by Messrs. Behm and Wagner, Europe has a population of 315,929,000 inhabitants; Asia has 834,707,000; Africa has 205,679,000; America, 95,495,000; Australia and Polynesia, 431,000; the Polar regions, 82,000, which give altogether a total of 1,455,923,000, an augmentation of 16,778,000 over the last known census. At the close of 1877, Germany reckoned a population of 43,943,000; Austria and Hungary, in 1879, estimated 38,000,000; Great Britain and Ireland, in 1879, 34,500,000; and France, in 1876, 36,900,000; Turkey in Europe, 8,860,000; and the Russian Empire, 87,900,000.

China has in Asia, in all her dependencies, an extent of 11,814,000 square kilometers, on which there are 434,600,000 inhabitants; Hong Kong has 139,144 inhabitants; Japan, according to the official census of 1878, had 34,300,000 inhabitants. The English possessions in India have a population of 240,200,000; the French possessions in India have 280,000 inhabitants; Cochin China has 1,600,000 inhabitants; Chinese India has 36,900,000; the East India islands have 34,800,000; and the islands of Oceanica, 879,000.

According to Dr. Nachtigal, Africa has an extent of 26,283,000 square kilometers, which are thus divided: Forests and uncultivated lands, 6,300,000 square kilometers; plains, 6,225,000 square kilometers; deserts, 10,600,000 square kilometers; steppes, 4,200,000 square kilometers. The English possessions in North America have a population of 3,800,000; the United States have 48,500,000; and Mexico has 9,485,000; and Brazil has 11,100,000. As to the Polar regions, they have an extent of 3,859,000 square kilometers around the Arctic circle, and are scarcely inhabited, except in Iceland, where there are 72,000 inhabitants, and in Greenland, where there are 10,000 inhabitants. The Antarctic regions have an approximate extent of 660,000 square kilometers.—Translated from "*L' Exploration*" by J. F.

The *Electrician* tells this story: A number of gentlemen were the other day about to dine, and one of the dishes was especially cared for, containing, as it was seriously averred, a "gymnotus," fresh from the rivers of South America, which was to form a part of the repast. Usually, electricians scrupulously observe decorum, but the chairman, instead of pronouncing the benediction, turned to the dish containing the eel and solemnly requested grace, when, with a sweet cadence, as if from a mermaid in cavernous regions, was heard all over the place, "Be present at our table, Lord," etc. The cover was then raised, and the anticipated electric eel turned out to be a telephone which had been ingeniously connected to a distant room, and which, being a religiously good telephone, not only produced a pleasing sensation to all present, but afterward returned thanks in a powerful but well-known voice to the admiring listeners.

XUM

THE GULF STREAM.

The papers read before the National Academy of Sciences yesterday were of much more general interest than most of those read on Tuesday. The morning session was devoted to reading and discussion of two contributions upon allied topics, "The Basin of the Gulf Stream," by Prof. J. E. Hilgard, and "The Origin of the Coral Reefs of the Yucatan and Florida Banks," by Prof. Alexander Agassiz. Recent surveys under Superintendent C. P. Patterson, of the United States Coast and Geodetic Survey, show that fully one-third of the Gulf of Mexico is less than 100 fathoms deep, the depth increasing very rapidly at about the 100-fathom line to a flat central basin, about 2,000 fathoms in depth. The two large plateaus, less than 100 fathoms beneath the surface of the water, are along the west coast of Florida, about 130 miles broad, and to the north of Yucatan, about 100 miles broad. These plateaus show the actual continental outline to be very different from the shore lines of the Gulf. Prof. Agassiz, in his paper, showed that these plateaus, whatever may have been their primal origin, are very largely composed of limestone, formed of the osseous carcasses of submarine life, and that whereas they had been in this way built up to the depth at which coral atolls or reefs begin to form—twenty-seven fathoms—as in the case of the Florida Keys and the coral islands north-west of Yucatan, coral atolls exactly similar to those in the Pacific described by Darwin were found. But Darwin had explained the Pacific atolls by a gradual, general subsidence of the bed of the ocean, and his theory was that all reef formations were accompanied by subsidence. Here in the Gulf the formation accompanies an elevation, and as similar plateaus are found in the coral regions of the Pacific, it is concluded that Darwin was all wrong, and that coral reef formations accompany elevations of ocean beds, instead of subsidence. During the discussion, the interesting fact was developed that the Gulf Stream, so called, does not come from the Gulf, as is represented in the physical geographies, but is an equatorial current which comes through the Caribbean Sea from the African coast, is turned north-east upon striking the coast of Yucatan, passes through the Straits of Yucatan and Florida and out into the Atlantic, without really entering the Gulf of Mexico at all. The currents in the Gulf are not connected with this great stream, and are very slow. The mouths of the Mississippi have already projected so far beyond the general coast line as to have nearly reached the precipitous declivities of the deep Gulf Basin, so there is no danger that the channel will ever be stopped again, or that the jetty system will have to be extended further into the Gulf than at present.—*N. Y. World.*

A California inventor has devised a process for pressing and drying potatoes so that they will keep for years without loss of flavor.

THE PREHISTORIC CAT.

The editor of the *Industrialist*, published at the Agricultural College of Kansas, gravely makes the following "forecast": "The December number of the *American Naturalist*, it is announced, will contain an article, 'copiously illustrated,' on the 'Extinct Cats of America.' We shall await the appearance of this number of the *Naturalist* with intense interest, feeling confident that this 'leading article' will lead to the solution of one of the great problems of science. Reasoning *a priori*—that surest road to truth in natural science—it must be plain to the dullest intellect that, where the 'extinct cat' is found, there will also be numerous billets of wood and boot-jacks, and possibly an occasional soap dish; and that all will be found in the neighborhood of a 'back fence,' we cannot for an instant doubt. Again, that a fossil bedroom window will be found near this back fence, opening upon it, we as surely believe as that the 'extinct cat' was ever a live one. Fortunately, science disdains not the meanest object of study, and to it we commend this bedroom window, leaving it wide open, so to speak, and feeling confident that near it will be found the *prehistoric man*, if not the 'missing link' itself."

The one unfortunate thing in house decorations nowadays, in the opinion of Mr. R. W. Edis, is the everlasting seeking after some novelty in papers, curtains, or other hangings. Everybody wants to have a room different from her neighbor. Decoration is being done as a fashion, not from any real love of it. Of course, we should not like to see room after room repeating itself in decoration, but why a few really good papers should not be the ground-work of true artistic decoration—when the narrowness of worldly circumstances prevents the more elaborate and more expensive hand decoration in paint or distemper—and let the rest follow from the design, there is no good reason. If that suggestion should be adopted, there might be hope for real art decoration instead of the cold formality and everlasting interchange of two or three colors. As a critical writer on art decoration has said: "If the papers on our walls and the curtains we hang in our rooms were, even at second hand, but the record of the fresh impressions and the graceful fancies of artists of our own day instead of being incumbered with mechanical pattern work struggling to be artistic, it would be better than all the present miserable striving after novelty." Not to have what your neighbor possesses is the bane of decorative art.

Celluloid Veneer is gaining favor as an ornament for furniture. As an imitation marble or malachite top for tables it shows most admirable fitness, and for panels in imitation of tortoise shell, etc., it is a handsome addition for chamber sets.

XUM

EDITORIAL NOTES.

SUBSCRIBERS to the REVIEW can obtain any book or periodical published in this country or Great Britain, or the publications of any of the prominent publishers of the United States, at reduced rates, by applying at this office.

A most important bill has just passed both houses of Congress, appropriating all the proceeds derived from the sales of public lands hereafter, to educational purposes. For the first ten years the funds are to be distributed on the basis of illiteracy, after that on the basis of population. The bill devotes thirty per cent to the higher education. Congress passed the bill without dissent, and it will undoubtedly become a law as it is in full accord with the genius of the American people and the spirit of the age. And there is true wisdom shown in carrying forward the higher and common school education *pari passu*, as they are mutually dependent on each other—the common schools sending forward students prepared for the higher grades, while the colleges and training schools return text-books and teachers.

THE Royal Geographical Society is considering the advisability of fitting out another Arctic expedition, not, however, with the design of making another attempt to reach the North Pole. It is to be devoted to an examination of the accessible polar regions, in the interest of science, and for the elucidation of certain questions in the physical geography of the globe.

THE Emperor William, of Germany, has been, during the last year, earning the gratitude of the archæologists. He has defrayed from his own private purse the expenses of the excavations at Olympia.

A MONSIEUR LOITEL has been recently dredging in the Sea of Galilee. It has a depth of 800 feet and contains twelve species of fish. The majority of these species have the singular habit of hatching their eggs and sheltering their young in their mouths.

DR. JNO. RAE, F. G. S., the noted Arctic explorer of England, says in a note dated Nov. 11, 1880, "I read many articles in your REVIEW with much pleasure."

ITEMS FROM THE PERIODICALS.

THE *Atlantic Monthly* numbers the ablest and best American writers among its contributors.—Longfellow, Whittier, Holmes, Lowell, Stedman and other renowned poets; Mrs. Stowe, Howells, Aldrich, James, Bishop, Rose Terry Cooke, Miss Woolson and other admirable writers of novels and short stories; W. W. Story, Norton, Warner Waring, and other skillful writers of travel and foreign life; Whipple, Fiske, Perry, Miss Preston and other careful and discriminating critics.

Since January, 1880, *The Atlantic* has been printed in new and larger type, on a larger page, and each number increased to contain one hundred and forty-four pages.

The number for February, will have an interesting and important article on German Credit-Unions, and a noteworthy paper on American Shipbuilding. Mr. John Fiske will contribute the first of his essays on our Aryan Ancestors; and Major Ben. Perley Poore an interesting chapter of his Reminiscences of Washington. There will be installments of Miss Phelps's and Mr. James's stories, and a short story, with the usual variety of essays, criticisms and poems.

THE *Manufacturer and Builder*, of New York, enters upon its thirteenth volume with the January number, and, under the editorship of Prof. W. H. Wahl has become one of the best journals of the class in this country. Monthly, 24 pages quarto, $2.00 per annum.

THE sixty-second Volume of *Harper's Magazine* began with the December Number. The February Number will contain an able paper. by the Rev. HENRY J. VAN DYKE Jr., on the Gospel History in Italian Painting, with a large number of fine illustrations; the conclusion of MONCURE D. CONWAY'S "The English Lakes and their Genii," with illustrations by ABBEY and PARSONS; a second paper on the Old New York Volunteer Fire Department, by G. W. SHELDON, illustrated; an illustrated article on Pottery in the United States; a paper entitled "Literary and Social Boston," by GEO. P. LATHROP, with eighteen illustrations; the third part of Miss WOOLSON'S serial story, "Anne," with an illustration by REINHART; the second part of THOS. HARDY'S new novel, "A Laodicean," (published exclusively in *Harper's Magazine*,) with an illustration by DU MAURIER; a paper entitled "The Early History of Charles James Fox," by the Hon. JOHN BIGELOW, a characteristic Georgia sketch, "Puss Franklin's Defense," by R. M. JOHNSTON; and other interesting reading-matter—poems, short stories, etc.

GOOD COMPANY, Number Fifteen, has an account of a steamboat trip to the head of navigation on the Missouri river by Mr. Herbert Hall Winslow, which happily contains information and incident, and is not wanting in graphic description of scenery and experiences with Indians, etc. in that little-known region of our vast Northwest. One of the novel and characteristic occurrences on the trip was a free fight among some of the steamboat hands.

Apropos of Dora d'Istria's recent visit to the United States, the story of that most remarkable woman's life is given. Mrs. M. S. Bull writes of the noble philanthropist Gerrit Smith.

There is an account of the origin and growth of the United States Life-saving Service, including some vivid descriptions of its members' experiences with wrecks; a paper on Eskimo traditions; an account of the Chinese professor and his family at Cambridge; and "Autumn Leaves," by E. S. Gilbert.

For fiction there is an installment of Ellen W. Olney's serial and several complete stories.

One or two shorter articles, with poems and the department of "Discussion and Suggestion," fill out the number.

WE learn from the New York *Observer* that Principal Dawson of McGill College, Montreal, delivered a course of lectures last month to the students of Auburn Theological Seminary, on the "Geological Features of Bible Lands, Illustrative of Bible History." The special topics embraced in the six lectures were: "Parallelism of Geological Chronology;" "Early Bible History;" "Geology of Egypt in Relation to the Hebrew Sojourn;" "The Sinaitic Peninsula and the Exodus;" "General Geological Structure of Palestine;" "The Dead Sea and its Geological History;" "Pre-historic Palestine–General Conclusions."

PROF. ASAPH HALL continues his articles upon the Advance of Astronomy, in the *Observatory;* also Prof. C. A. Young, of Princeton, who contributes an article upon the Spectrum of Hasting's Comet.

No magazine published in the United States has made more brilliant progress within the past few years than the *North American Review*. It enters on its sixty-sixth year with the January number, which is full of excellent articles by some of the ablest writers of the present day in America. Its contents are as follows:

"The Philosophy of Persecution," by Prof. JOHN FISKE; "Controlling Forces in American Politics," by Senator GEO. F. EDMUDES; "Atheism in Colleges," by JOHN BASCOM, D. D., LL. D., President of the University of Wisconsin; "The Ruins of Central America," Part V., by DESIRE CHARNAY; "Partiran Government," by WM. D. LE SUEUR; "Popular Art Education," by Prof. JOHN F. WEIR, Director of the School of Fine Arts, Yale College; "The Limitations of Sex," by NINA MORAIS; "The Mission of the Democratic Party," by Senator WM. A. WALLACE; "Recent Philological Works," by Prof. F. A. MARCH.

XUM

MR. WILLIAM FARNELL in a short article in the *American Microscopical Journal* denies that the *Drosera brevifolia* and the *Saracenia varioloris* are insectivorous plants, claiming that he has gathered them at all proper seasons and never found any insect caught in the first, and that whenever he found any remains of them in the second he invariably found at the bottom of the tube a white worm with strong black mandibles, which was evidently the insectivore.

THE *Scientific American*, for Dec. 25, has a communication from Andrew Van Bibber, combating the popular idea that rain always follows heavy cannonading, and giving several instances in his own experience, for instance, at the battles of Shiloh, Corinth, Lookout Mountain, and Missionary Ridge, where no rain followed the heaviest artillery explosions.

We give a table showing the coldest day of December in each year since 1875.

			7 a m.	2 p m.	10 p m.
1875	Dec.	17	-2	11	9
1876	"	29	-4	4	-3
1877	"	1	10	29	24
1878	"	25	-4	7	3
1879	"	24	-7	2	-7
1880	"	28	-6	-2	-10

THE subcutaneous injection of sulphuric ether in three-drop doses, at intervals of twelve hours, is recommended by Dr. Comegys for the successful treatment of sciatica; and he thinks that the substitution of ether for ergotine in dealing with tic-doloreux would give good results.

THE weather for the last few days of December was remarkably cold. On the 28th at Chicago, the mercury fell to —18°, at St. Louis to —10°, at Minneapolis —28°, at Fort Garry —41°, at St. Paul —25°, at La Crosse —20°, at Milwaukee —19°, at Leavenworth —16°, at Kansas City —10°.

MR. Frank Buckland, the well-known naturalist and pisciculturist, is suffering from a severe attack of dropsy, and now lies in a very critical condition.

THE December meeting of the Kansas City Academy of Science was held on the 28th ultimo, and there was a good attendance notwithstanding the extreme coldness of the weather. Mr. W. H. Miller read his third paper on the Synthetic Philosophy of Herbert Spencer, which was well received by the Academy, and is published in this number of the REVIEW.

Col. R. T. Van Horn read a paper on "A New Hypothesis of Life," in which he took up and treated the radiant form, or fourth form of matter, suggesting that possibly this form of matter might present the primordial environment and conditions of life, of whose origin, science so far has made no revelations. There is no physical basis of life, material forms only giving its conditions and environment. The paper was original, fresh and cogent, but as it will appear in the February number of the REVIEW in full, we will attempt no abstract of it now.

PROF. J. S. Newberry, an unquestioned authority on the subject, said in a recent address before the National Academy of Sciences that the quantity of iron in Utah is such as to throw into the shade all other known deposits in this country.

OF late the electric light has been employed by naturalists to attract insects, which they desire to collect for examination or to preserve as specimens.

Geological explorations have shown the probability that Russia contains beds of phosphate of lime of sufficient extent, to supply Europe for an indefinite period.

PROF. Strasburger, of Jena, holds that the attributing of all the functions of life to protoplasm, is to be looked upon as a great advance in science, although it is impossible thus far even to form hypotheses with regard to the forces which are at work in the protoplasm.